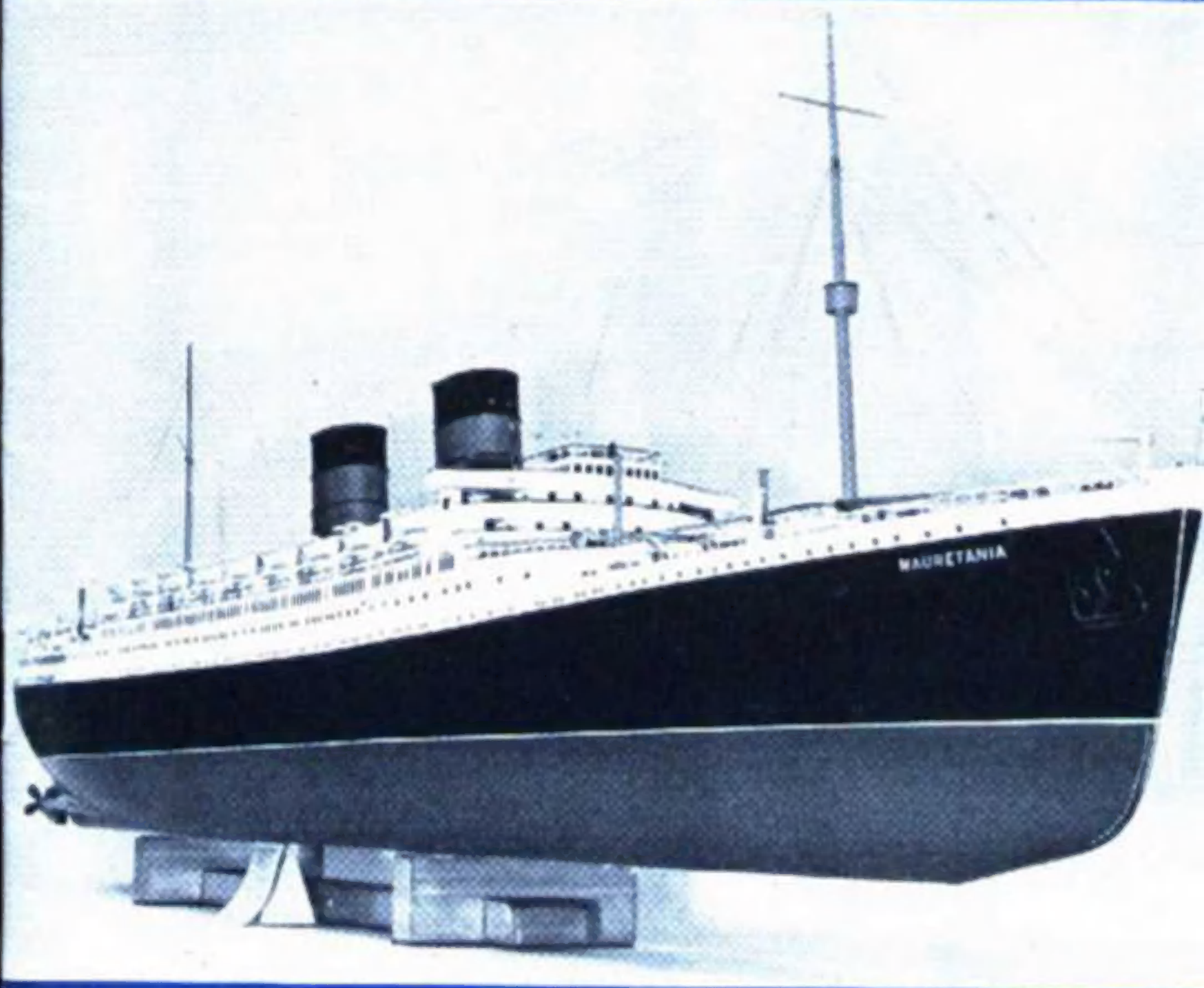
THE MODEL ENGINEER



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APRIL 23rd 1953
Vol. 108 No. 2709

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THE MODEL ENGINEER

EVERY THURSDAY

Volume 108 - No. 2709

APRIL 23rd, - 1953

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1

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Our Cover Picture

The subject of our photograph is a model of the Cunard liner *Mauretania*, which replaced her namesake, the famous holder of the Blue Riband, a few years ago. The model, which was exhibited at the Northern Models Exhibition, held recently in Manchester, was built by the brothers William and Arthur Derbyshire of the Crosby Model Club, and was launched by Mrs. Percy Furness, the wife of a Cunard line director, in the summer of 1951. She had her maiden voyage on August Bank Holiday last year. She has a metal hull with properly laid strakes, and is electrically driven. The scale is $\frac{1}{8}$ in. to 1 ft., resulting in a model just over 8 ft. long. We published a photograph of her afloat in the October, 1952, issue of *Model Ships and Power Boats*. On the water she is most impressive, and with her perfect proportions she has all the dignity and grace of her prototype.

A small working model of a liner is often a disappointment, as, if a reasonable amount of detail is included, the model is too delicate for the handling a working model usually receives. But at the scale of this one, the detail is quite robust and stands up well to the requirements.

SMOKE RINGS

Who is Stifling Progress?

A WELL-KNOWN reader seems to be very much annoyed by our recent comments on the subject of free-lance modelling ; he writes —

"I have read and re-read your editorial paragraphs in the February 19th and March 12th issues, and I write to express my strongest disapproval of them. If a model maker is not to be free to make whatever changes he may fancy, or may even be forced to make while building his model, then he may just as well give up model making and take to something else in which he will be more fairly treated. It seems to me that your opinions, if generally adopted, could have no other effect than to stifle any progress in model engineering."

To say that we are surprised by the interpretation he has made of our remarks is to put the matter very mildly. We too have read and re-read our paragraphs and can find nothing in them to suggest that we desire to stifle progress. The idea we had in mind when we wrote the paragraphs, which our friend has so patently misinterpreted, was the exact opposite, and we believe that this must be apparent to anyone who reads and digests the said paragraphs. After all, consider the case of any *working* model steam locomotive ; here, changes and departures from the prototype are essential to success, but they do not necessarily involve alterations to the prototype practice in any detail, still less to appearance.

Andover Traction Engine Rally

THE PERSISTENT bad weather during the previous week caused the rally at Andover, on Easter Monday, to be a disappointment. Not all of the expected entrants were able to attend, and those that did were severely hampered by the extremely muddy conditions of the ground. The result was that the obstacle-race which had been planned was abandoned.

All the same, most of the large numbers of people who attended seem to be well satisfied with the sight of so many road locomotives, steam tractors, steam wagons and a steam car, all in steam together. Few of the visitors, apparently, had seen such a sight, the novelty and enjoyment of which more than atoned for the unavoidable alterations to the main programme.

Two passenger-carrying locomotive tracks were kept very busy ; one was a $7\frac{1}{4}$-in. gauge track on which a fine $1\frac{1}{2}$-in. scale L.M.S. "Royal Scot" was working faultlessly ; the other was a $3\frac{1}{2}$-in. gauge track on which a delightful $\frac{3}{4}$-in. scale Great Northern Ivatt Atlantic, a beautifully exact little copy of its famous prototype, was performing in the manner commonly expected of these engines, whatever their size.

The weather and the state of the ground combined, towards the end of the afternoon, to provide an unusual spectacle ; this was the "rescuing" of the bogged-up engines and manoeuvring of them back to the hard high road ! These proceedings were watched with intense interest by a large crowd ; and, in spite of some difficulties, all ended successfully and well.

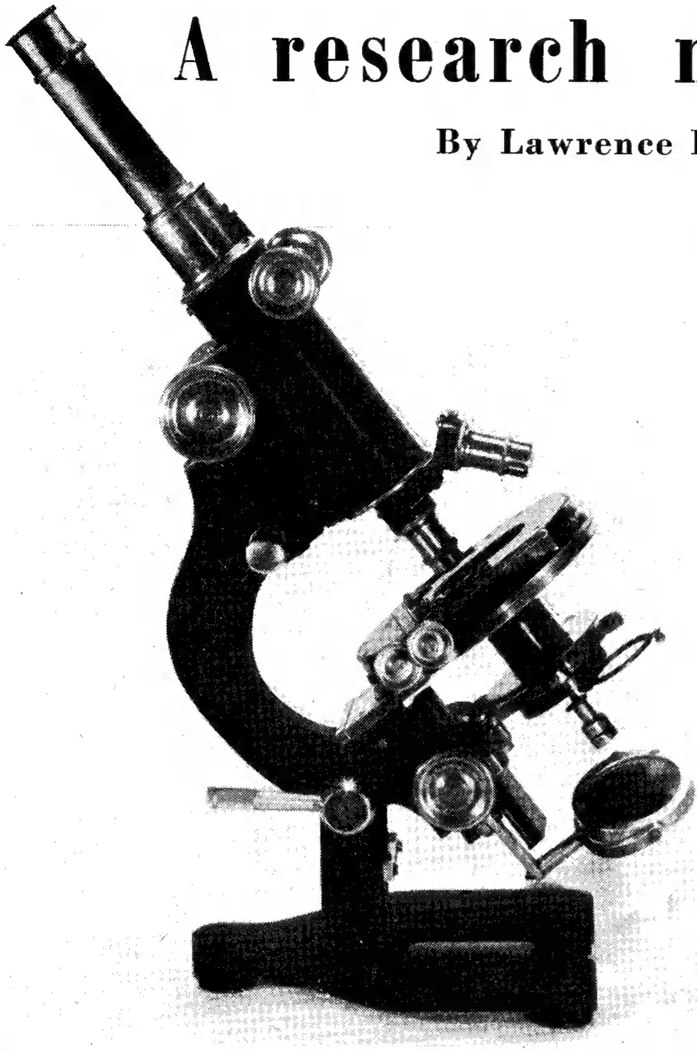
Exhibition at Nottingham

A LETTER from Mr. A. J. Witty, who is exhibition secretary of the Nottingham Society of Model Engineers, informs us that the society's sixteenth exhibition will be held at the Victoria Baths, Nottingham, from September 23rd to 26th next. Mr. Witty hopes that this advance information will be duly noted by kindred societies, so that their dates may be fixed accordingly. He would also be glad to hear from other societies and provincial lone hands who may be willing to co-operate by loaning models for the customary competition section which will offer attractive awards.

Mr. Witty's address is : 48, Harrow Road, West Bridgford, Nottingham.

A research microscope

By Lawrence H. Sparey



The microscope with the movements extended. The substage and filter-holder have been swung out

THE microscope is much more than just an instrument for making things look larger. It is handmaiden to all the sciences. To the chemist and the engineer, to the doctor and the agriculturist, it is final judge and referee. It is as potent to save the life of the injured and sick as it is to detect the evidence that sends another to the gallows.

The microscope is a magician. It conjures beauty in unlikely places. A beetle's wing becomes a dozen rainbows; a bamboo-section is yellow primroses scattered over grey lace on a shining field of silver.

The microscope is a philosopher. It brings us to our right proportions. It shows us other worlds, infinitely small yet infinitely complex, against which our most intricate workmanship is crude blundering.

Not all model engineers are agriculturists; neither are they chemists; nor are they all doctors, although a goodly number of them are. Yet all of us have one thing in common—a great curiosity. We like to see how things work; to study them in their finer details. We are interested in things which lie outside the daily round of living.

If this, indeed, be true, then I need try to whet your appetities no further. The microscope I am about to describe will be its own justification should you care to make one.

As for the making, I think it best to say at once that this is not a job for the beginner. I am sorry about this. I should like to have said that it was suitable for the merest novice. It so increases one's scope and popularity. But try as I will I cannot bring myself to tell the lie. So it is to the more seasoned engineer that I must address my remarks—unless there be among us some Mozart of the lathe who is already composing rhapsodies in brass and steel at the age of seven.

Not that the instrument is presented as anything phenomenal. It was made entirely on a $3\frac{1}{2}$ in. lathe, with only average skill used with infinite care. It is just that a microscope will not stand any errors in construction if it is to be of any use. It is an instrument of magnification, and certain errors can be magnified a thousand times or more in actual use. For instance, should the stage be two thous. out of line, this will become two inches at a magnificaion of 1,000 times, and part of a specimen when viewed will be badly out of focus. But more of this anon.

In view of its appeal to the more experienced workman, machining set-ups will not generally be shown. If you can make the instrument successfully, then you can devise your own settings. At the same time, certain little hints and dodges will be mentioned as they arise.

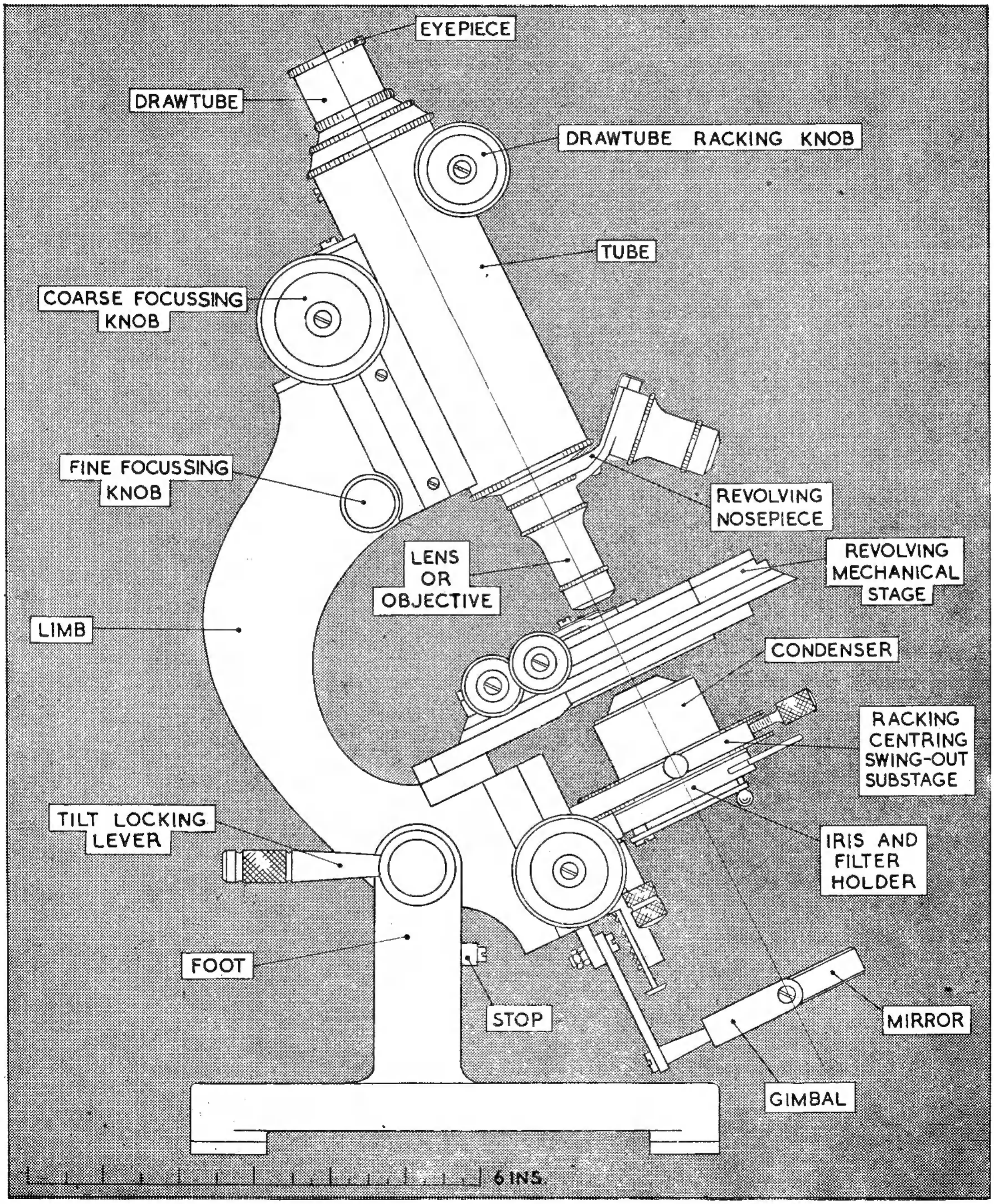
General Observations

Like the human body, the microscope is one of those things that everyone knows well but few know anything about. It may be as well, then, to spend a few paragraphs at this stage on some general remarks which may help us to understand things to be described later.

One of the most prevalent misconceptions about the microscope is that the larger we make an object appear the better shall we see it. This is not so. Mere magnification in itself is of little use. It is the detail we see that matters. To make this point clearer, let us imagine that we have taken a photograph of a house and garden situated at some considerable distance from us. On inspecting the photograph we shall note that, while the general layout and appearance of the scene

is preserved, the bushes and other details of the garden show as mere blurs. Suppose now that in order to distinguish the holly from the laurel, we proceed to enlarge the picture. Will this help us? Certainly not. All we shall get is larger and larger blurs, and though we enlarge until out picture is the size of a railway hoarding, we shall see neither leaf nor berry. So it is with the microscope.

Definition, or *resolution*, as it is called, depends on several factors, such as the quality of the lenses, sharpness of focus, and such like, but quite as important as any of these is correct *lighting of the object*.



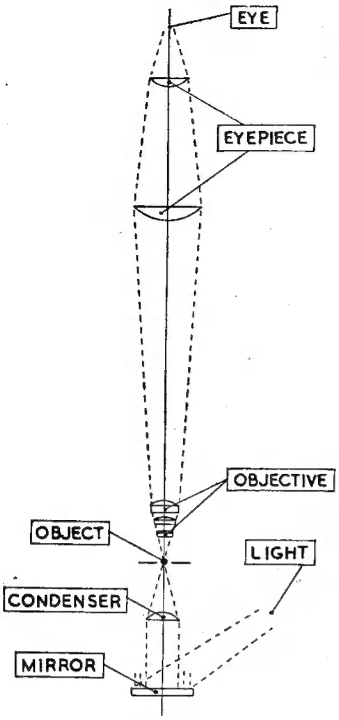


Fig. 2

It is true to say that, using any given lenses and focussing arrangements, the resolution can be improved several hundred per cent. by correct lighting alone.

For this reason the modern microscope is provided with elaborate substage devices, such as condensers, iris, and filters, with sensitive focussing arrangements. A glance at the photograph of the substage of my own instrument will show that some of the most intricate work of the whole microscope lies beneath the stage.

Owing to the fact that some of the cheaper microscopes are supplied without substage mechanism or, indeed, often without a condenser, the question may arise as to whether all this seeming complication is really necessary. The answer is that it is essential for all serious work.

In order that we may appreciate the theoretical side of the question, I have made the sketch shown in Fig. 2. This sketch shows, in the simplest possible manner, the optical and lighting arrangements of a compound microscope. I am well aware that this sketch, while theoretically correct, is not correct as to shape and positions of lenses, the bending and scattering of light rays, and so on. Please do not write to tell me so.

Starting from the *mirror* at the bottom of the diagram, we see that the light is reflected upwards into the *condenser*, from which the light rays converge to a point upon the *object* to be viewed. From here the image passes through the lenses of the *objective*, whence a magnified image is projected, to be intercepted by the *eyepiece*, and finally realised by the *eye* and brain of the observer.

From the above it will be seen that some form of focussing device is necessary on the condenser in order that the rays of light may be truly focussed upon the object. Light means resolution, and just as you cannot see to read clearly in an almost darkened room, so the microscope cannot see detail in a half-light.

The iris diaphragm is also a necessary control, not only over the intensity of the light, but also on the depth of focus of the illumination. The advantages are most marked when objects of any " thickness " are to be examined.

In the photograph of the substage shown here, the filter holder will be seen, and also in the picture of the extended microscope. Filters are a great convenience, as some objects having colour may be better seen in coloured light. In addition to this, when viewing, at high magnification, minute objects which approach in size to the wavelength of light, more resolution may be obtained by using light at the violet end of the spectrum, where the wavelengths are shorter. Obviously, one cannot see an object which is smaller than the light wavelength used. Filters become a necessity if photo-micrography is to be undertaken.

In view of the importance of light in the use of the microscope, I hope, with the editor's permission, to add a few notes upon the correct manipulation of the microscope, at the end of these constructional articles.

In passing, it may be observed that the latest development, the *electron microscope*, can resolve very minute objects because of the ultra-short wavelengths which can be employed.

Microscope Details Described

It is now time to turn our attention to the drawing, page 491, in order that we may become familiar with the various components, and that we may point out those parts which are usually purchased ready made. These do, of course, include the lenses, eyepieces, and the condenser, as the making of these is a highly specialised matter. The instrument without these optical arrangements is known as the *microscope stand*, and when buying a complete microscope it is usual to purchase the stand separately, and then to buy the optical units as necessity, or the pocket, dictates.

Eyepiece

This is an arrangement of lenses assembled within a tube, and they may be had in various powers of magnification varying between about 5 to 25 times. In microscope work, magnification is usually denoted thus : X 10 ; the " X " being the multiplication sign, denoting, in this instance, that the magnification factor is by 10. Generally speaking, the lower powers are the most useful, as it must be remembered that the eyepiece gives magnification only, and the high powers tend to restrict the light.

The eyepiece is a slide fit within the drawtube.

Drawtube

As may be seen in the photograph of the extended microscope, the drawtube may be pulled out for a restricted distance from the main tube of the stand, for which purpose it is made to be a sliding fit. In this actual instrument the drawtube is double, as there is a short portion which may be raised or lowered by means of a rack and pinion. This is, admittedly, a refinement, but is useful for adjusting the microscope to compensate for various thicknesses of cover glass on the microscope specimen slide.

The lower end of the drawtube is restricted with an annular ring, forming a light stop which adds to the depth of focus.

Tube

The body tube of the microscope carries at one end the drawtube, and at the other a fitment screwed for the standard objective thread.

The tube is mounted on vee-slides, and coarse movement is controlled by rack and pinion.

Fine Focussing Adjustment

In the drawing and photographs will be noted the fine focussing knobs which project from both sides of the instrument. These do not operate a rack and pinion system, but control a lever movement giving a most remarkably fine degree of control. One complete turn of the knobs raises or lowers, the tube 0.0015 in.

The fine focussing movement also operates on vee-slides, and upon these is mounted the whole coarse focussing arrangement. We thus have two sets of slides one behind the other.

The Limb and Foot

The *limb* forms the main body of the microscope, upon which are mounted all the components. The limb is carried by the *foot*, and is pivoted to enable the instrument to be tilted, and locked in position by a lever. The foot is of the well-known "horseshoe" shape, and is provided with three rubber feet.

Revolving Mechanical Stage

The *stage* is that part of the microscope upon which the object to be viewed is mounted. These objects are usually set into glass slides of standard size, and clips are provided to hold these.

The simple types of instrument have only *plain stages*; that is, a simple platform carrying clips to secure the specimen, which is positioned by hand. The *mechanical stage*, however, is provided with compound vee-slides, mounted at a right-angle to each other, and actuated by means of small knobs. We thus have delicately controlled movement from side to side and forward and backward, so that we may locate the specimen in any desired position.

The beauty of this arrangement is that we are able to use vernier scales, by means of which very accurate and minute measurements may be obtained. This is done by inserting into the drawtube a disc of plain glass upon which a hair line is engraved. This is known as a *graticule*. In practice, the hair line is seen imposed upon the specimen, which is then adjusted so that the line coincides exactly with one edge. The vernier reading is then noted. The stage is then moved until the line coincides with the opposite side of the specimen, and the vernier reading again noted. By subtracting the one reading from the other, the size of the specimen may be determined.

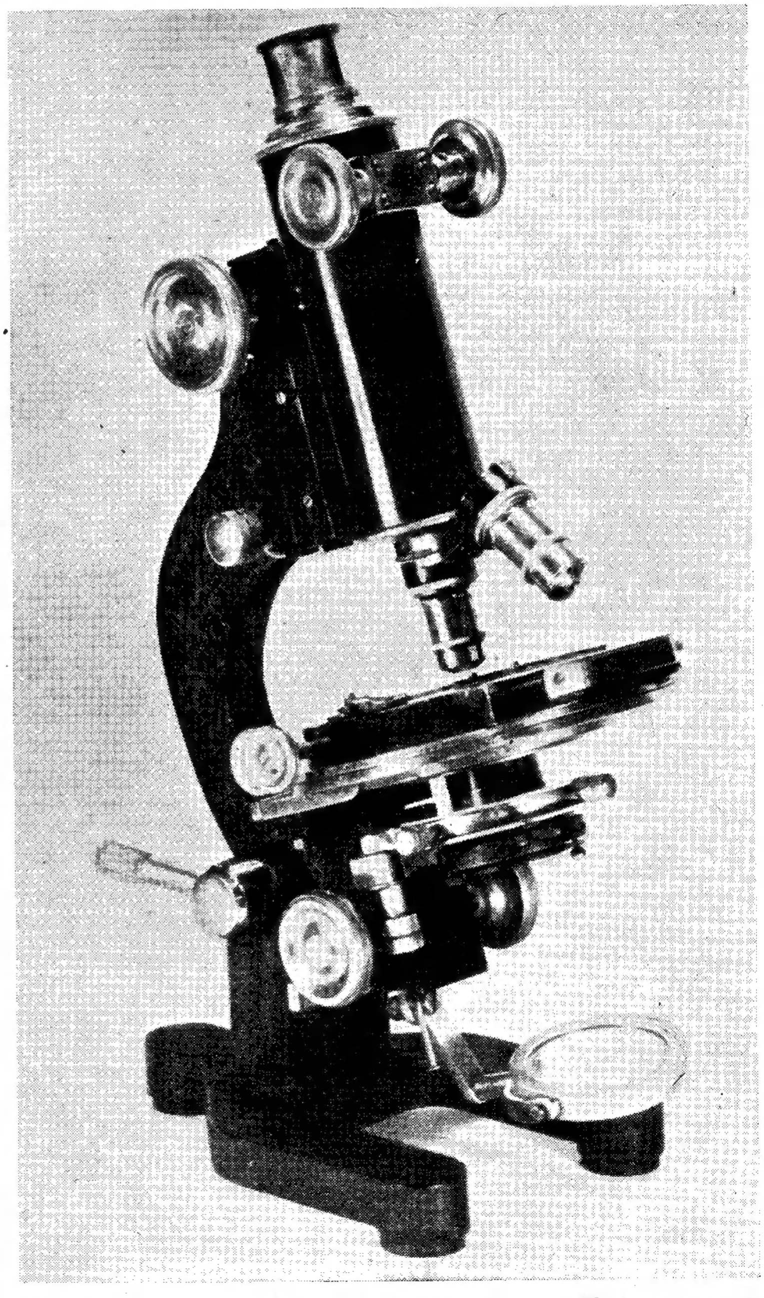
In the instrument shown here, the back and forth movement is obtained by means of rack and pinion. Cross movement is by means of a two-start thread and nut, of $\frac{1}{4}$ in. pitch, cut upon a 5/32 in. silver-steel shaft.

An advantage of the type of stage shown is that, by removing the slide-clips, a completely clear platform is presented, upon which flat objects, such as culture plates and petrie dishes, may be mounted.

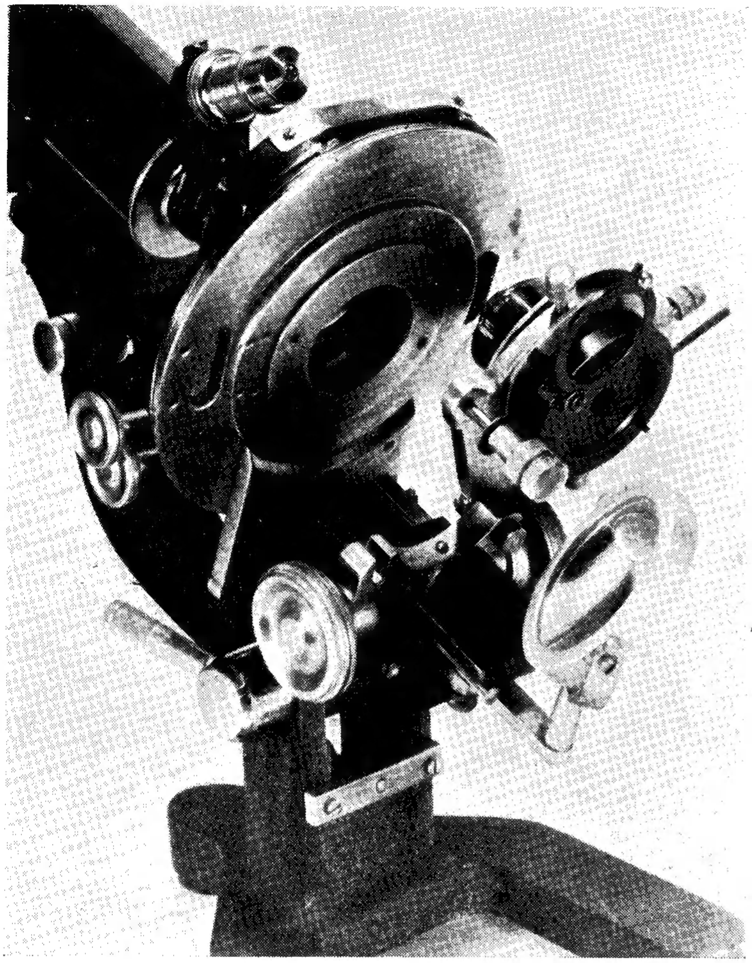
For certain classes of work, notably metallurgical and petrological, it is necessary that the stage may be revolved, especially when viewing structure by polarised light. Our microscope does not fail in this respect, as the stage is mounted upon two plates, which revolve one upon the other on a large ball-race. The edge of the upper plate is engraved in degrees, so that the amount of rotation may be determined.

Substage

A certain amount of information



A research microscope embodying most modern features. The instrument can be made on a $3\frac{1}{2}$-in. lathe



View of the microscope from beneath the rotating mechanical stage, showing how the condenser may be swung out of the optical axis of the instrument. Note the filter-holder and the iris diaphragm, and screws for centring the condenser

has already been given about this. It consists essentially of a bracket, which is mounted at a right-angle to a vee-slide, and actuated by a rack and pinion.

The bracket carries a condenser, and is designed to house the somewhat curious standard size of 1.527 in., so that a purchased condenser will fit. These condensers may be obtained complete with iris and filter holder, but these may be fitted to a plain condenser if necessary.

A most important feature of the condenser housing is that it is spring-loaded and fitted with three adjusting-screws, by means of which the optical arrangement may be centred with the objective. This is an essential for serious work, as will be readily understood from our previous remarks upon the importance of lighting.

The whole illuminating apparatus is arranged so that it may be swung clear of the field. This is desirable when viewing certain objects under various powers, when the condenser may not be wanted. It is also of great help in setting the mirror prior to adjusting the substage condenser.

The Mirror

A special microscope mirror must be obtained, having a concave mirror surface on one side, and a plane surface on the other. The mirror is mounted within a metal frame, upon a gimbal attachment giving universal movement.

Revolving Nose-piece

It is often convenient to adjust the microscope for viewing a certain object using a low powered objective, changing to an objective of higher magnification later. Should it be necessary to unscrew one objective and replace by another, the delicate adjustment of the substage may be upset by accidental movement and vibration. It is, therefore, a great convenience to be able to swing one objective out of line and substitute another in one rapid movement. For this purpose a revolving nose-piece, carrying two, three, or even four objectives, may be mounted upon the tube.

I have made nose-pieces of all these types, but have, for simplicity, depicted the two-way pattern. In all of them the principle is the same, and the number of objectives carried is simply a matter of elaboration. I hope to give drawings of these at a latter date.

Remarks

From the above brief description it will be seen that this instrument is comprehensive, and that the work entailed in its manufacture is, while not difficult, extensive and precise. Although I possess both a milling machine and a shaper, the prototype was built by me entirely on my $3\frac{1}{2}$ in. ML7 lathe, and this was done in fairness to those constructors who may not be so well equipped. Should you possess either of these auxiliary machines, the job will be quite routine practice.

There are only two castings used, those for the limb and the foot, and I am making arrangements for these to be available. Further information about the specifications and supply of the optical parts will also be given.

Finish

In the original instrument, all the principal parts are of brass, which are finished in black enamel and chrome plate, but in view of the difficulty which often prevails today in obtaining chrome finish, certain of the parts, such as control knobs, may be of dural, without affecting unfavourably the weight and stability of the instrument.

Finally, it may be said that should you tackle this intriguing proposition, you will obtain not only many interesting hours in the workshop, but an instrument of fascinating possibilities, valued at around seventy to eighty pounds.

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

CAMERA DESIGN

DEAR SIR,—When I lived within reach of London, it was comparatively easy to find any odd material I wanted, in one or other of the Clerkenwell shops, but, now that I am "put out to grass" and live in a small country town, I find I am often driven to abandon making this or that, because I don't know how to obtain some piece I cannot make.

As there must be many in my position, may I ask you to encourage writers of descriptive articles to indicate to whom one should write for such materials ? I am encouraged to make this request because some such writers already do so, and your readiness to help is so well known to us all.

At the moment I am quite "set fast" to discover the source of the "gold-plated glass," the "1 in. negative lenses," and the "Perspex 905 neutral" mentioned by Mr. Widdas in his letter on page 97 of your issue of July 17th, 1952, and I am taking the liberty of bringing my requirements to the notice of your readers, in the fond hope that it may result in obtaining some likely addresses.

Yours faithfully,

Lymington A. RICKARD TAYLOR.

EAST ANGLIA'S FIRST STEAMBOATS

DEAR SIR,—I would like to thank Mr. F. J. Howlett for his interesting letter in your issue for March 12th, and explain the points he raised relating to my recent article on the above.

Regarding the drawing on page 140, in preparing this I adhered as far as ever possible to the Trevithick-Murray engine as illustrated in the Goodrich Papers, where the cylinder is definitely inclined downwards towards the crankshaft and where the paddle shaft above has only one central crank. The flanges which appear to be the end of the return flue over the chimney are, in fact, an inspection cover, and, although not too easily seen in my drawing, is shown much clearer in another drawing in the Goodrich Papers of another engine for factory purposes.

In my drawing, my speculation is confined to the layout of the parts of the engine, all these parts being from authentic Murray-Trevithick engines. As I pointed out in my text, the exact configuration of the engine in *L'Actif* is open to conjecture and will remain so until some historic document or fact is discovered to show precisely how it was arranged.

I think Mr. Howlett may be confusing the hypocycloidal straight-line motion with the sun and planet gear. In the latter, the flywheel does make two revolutions to two strokes of the piston, but in the former I can assure him the flywheel makes only one revolution to two strokes of the piston, the pitch circle diameter of the pinion being half that of the annulus. Thus, an ordinary eccentric will operate the valve, and in my model (not shown on page 139) it leads the crank by 90 deg. plus 26 deg. Mr. Howlett is very welcome at any time to see my engine at work.

Yours faithfully,

Norwich. RONALD H. CLARK.

MODEL LOCOMOTIVE SUPERHEATERS

DEAR SIR,—I do hope that nothing I have said has cast any doubt on "L.B.S.C.'s" ability to work out and develop such things as the fire-tube superheater as applied to model sizes. What I ventured to question was his claim that his *Ayesha* was the first 2½-in. gauge locomotive to have this development. *Ayesha* did not come into being until about three years after my engine was made, and two years after the drawings were published in THE MODEL ENGINEER, and further notes of "L.B.S.C." on this subject establish that *Ayesha* was indeed the first "L.B.S.C." locomotive to be so equipped. Both of us were, however, forestalled by Mr. Twining's design of 1915.

Many of us, in our younger days, have also had to "make do." 50 years or so ago, money was treated with very great respect; nowadays, young people seem to be able to get pounds where we only got sixpences.

As regards those exhaust nozzles, "L.B.S.C." cannot have it both ways; in December last he was spurning my No. 3 because it once had a 5/64-in. nozzle; now it is the large nozzle that arouses his scorn. Perhaps, however, there may be something in what he says ? I expect my engines do use more steam, my track has 1-in-36 gradients, his is dead flat, and the locomotive exhaust is not quite self-regulating over extreme ranges; but the better the design of the exhaust passages, the larger may be the actual nozzle.

Finally, I would ask our worthy friend not to be quite so bitter about the controversy of 30 years ago; must he always remember the opposition which was really comprised of only two individuals ? Cannot he remember the almost universal support he obtained from the rest of the model locomotive fraternity ? After all, he did win his point.

Yours faithfully,

Bexhill-on-Sea. C. M. KEILLER.

SLIDE RESTS FOR DRILLING MACHINES

DEAR SIR,—With reference to Mr. Bond's letter concerning Mr. Kerswell's compound milling table, your correspondent may be interested to note that at the time the article was published, we had completed the design for a similar attachment, and also for a drilling machine, sufficiently rigid to resist the stresses set up by milling operations, to which the attachment may be fitted. Castings for these are already in hand, and will be offered in the near future, pre-machined as usual.

In considering the use of a drilling machine in this manner, it should be borne in mind that a well-fitted spindle of ample diameter, and absence of play of the quill in its bearing, are essential for good results. It is also highly desirable that end-mills should be drawn back into the spindle in some form of collet, rather than be held in a drill chuck, in order that needless overhang be eliminated.

Yours faithfully,

Watford. E. W. COWELL

BRITISH CRAMPTON LOCOMOTIVES

By E. W. TWINING

PART 3

FOR the period and for the narrow, or 4 ft. 8½-in. gauge, the speeds of which the stern-wheel Crampton engines were capable of attaining were generally greater than those of other types on all other lines, and were only exceeded on the broad gauge of the Great Western Railway. The *London* on the gentle gradients of the London and Birmingham track could run her sixty miles an hour with ease, hauling trains made up of ten four-wheeled carriages; say 50 to 60 tons weight. D. K. Clark states that this engine once took a train of eleven such coaches at 53.4 miles an hour in a run of 30 miles.

One of the Tulk and Ley Belgian engines, tested on the Grand Junction Railway, forming from 1846, part of the Northern Division of the L. & N.W. Rly. gave such satisfactory results that it was decided that the company should build such an engine in their own works. This locomotive to which the name *Courier* was given, was, in the main designed by Crampton and was constructed at Crewe with some modifications by Alexander Allan, who was in charge under Francis Trevithick, the locomotive superintendent for the Northern Division.

The engine was completed in November, 1847, and differed in many important respects from previous Crampton engines. One of these differences was an additional frame-plate extending from the cylinders to the motion-plate and thence to the rear buffer beam. This marked the commencement of the practice of using double frames, from 1848 onwards, on all Crampton engines. The valve-gear was no longer of the Stephenson lifting link type, but Gooch's which worked the valves through rocking shafts and levers, the valve-chests being on top of the cylinders and not at the side, as in the Tulk and Ley lot. A considerable amount of wisdom was shown in adopting this gear, for it was far more convenient as regards linking up and reversing, the movement being more direct from the driver's lever and the necessity for the double-cranked arm was avoided. The use of the Gooch gear was doubtless proposed by Crampton himself, who must have been aware of the awkwardness and poor design of the connection to the Stephenson link in the first seven engines. Be that as it may, this was the only instance of the Gooch gear ever being introduced into a Crewe-built engine.

No eccentric sheaves and straps were used in the *Courier*; instead, there was the usual return-crank with its pin, but this was set over at an angle to the main crank centre-line. The pin took a rod to the expansion link for forward gear and from this pin a further short return crank passed over to the other side of the centre with another pin for the back-gear rod. The ends of each rod were fitted with adjustable brasses, gibs and cotters in a similar manner to connecting-rods but of smaller size. A drawing of the complete engine is reproduced in Fig. 6, which unfortunately is unable to show the return cranks and rod-ends, these being hidden by the outside frame; a separate detail has therefore been added and this is the subject of Fig. 7. This is, more or less, diagrammatic, but it will be seen that the angular advance of the eccentric centres, which provide for lap and lead of the valves, is of a negative kind; that is to say the eccentric pin centres are on the same side of the axle centre as the main crank-pin, and moreover, when the main crank is on its back centre the eccentric rods will be crossed. This is because the valve spindles are driven, by the radius rods, through the medium of rocking levers which of course reverses the positions of the valves. A big-end for one of the rods is added below the diagram.

The boiler was of the typical Crampton pattern, that is to say; it was double segmental as regards the barrel with a firebox only two feet long at the top and lengthening out to nearly five feet at the bottom, being extended forward under the barrel and backwards under the driving axle. The top of the outer firebox shell was carried upwards to 1 ft. 9 in. above the barrel in order to give an additional volume of steam above the water. From this an internal pipe led to the dome on the middle of the boiler barrel, in which dome the regulator was situated. From the regulator two pipes branched and were taken out through the boiler plates, one on each side, and so down, externally, to the valve-chests. Apparently there was no lagging, or covers, over these pipes. The dome casing, of brass, was of typical Allan design.

The driving wheel diameter was 7 ft.; the four carrying wheels 4 ft. diameter. The wheelbase, from

(*Continued on page* 501)

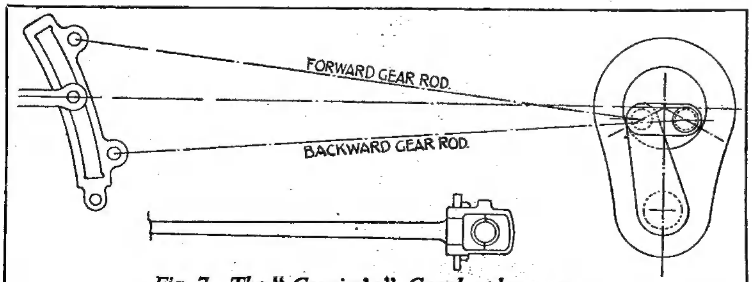


Fig. 7. The "Courier's" Gooch valve-gear

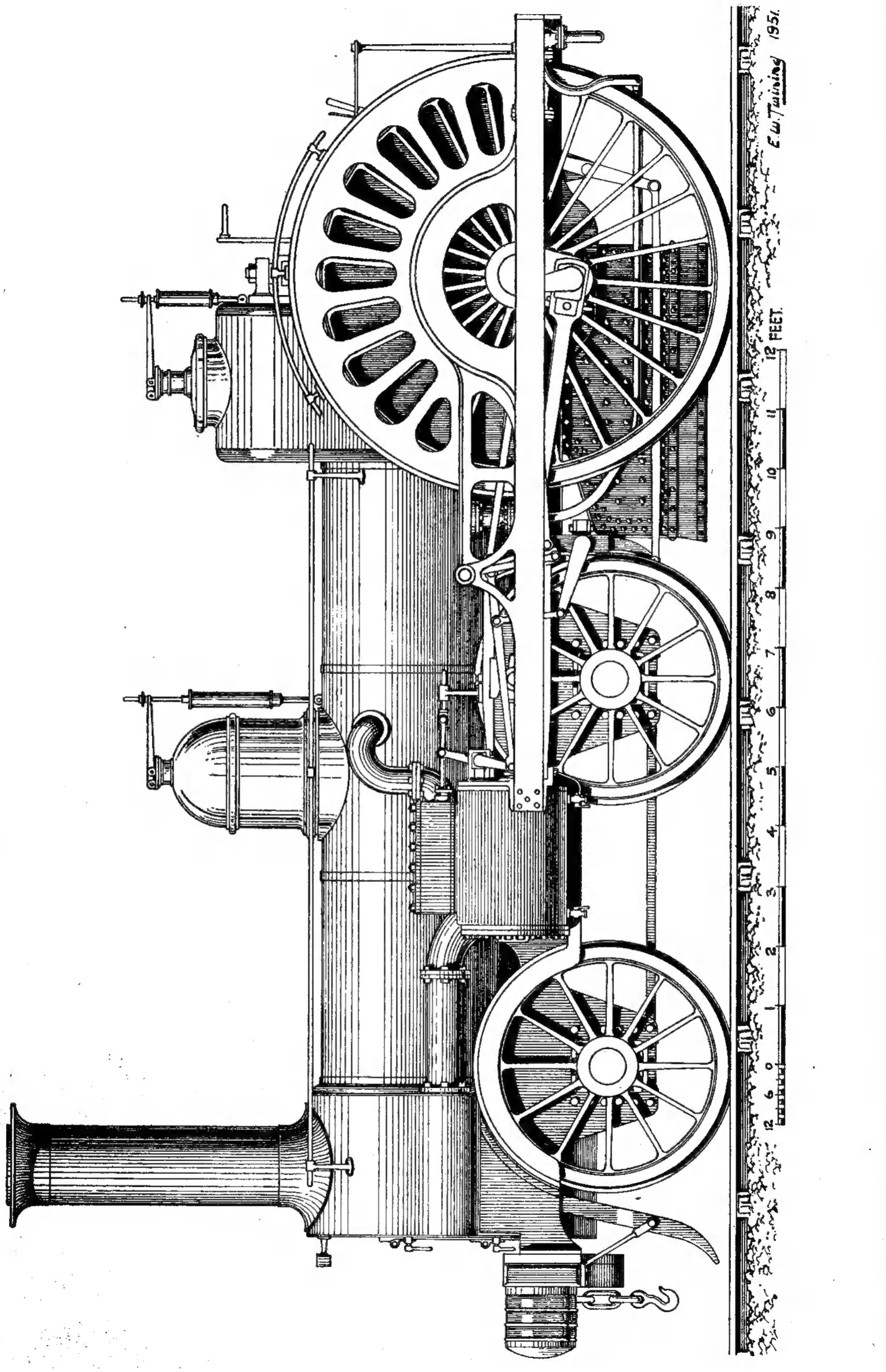
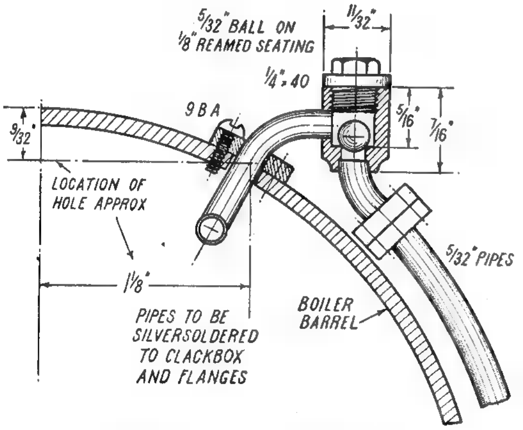


Fig. 6. The L. & N.W.R. Crewe-built engine, "Courier," 1847

L.B.S.C.'s "Britannia" in 3½ in. Gauge

TOP FEEDS AND BOILER DETAILS

HAVING now finished the sheet of drawings that "ran late" last week—did I hear somebody remark that British Railways sometimes run late !—we can now resume business. In many previous descriptions of locomotives whose big sisters have top feeds, I have specified the upper delivery clacks to be fitted inside the frames, and have added a dummy top clack arrangement, just to delight the heart of Inspector Meticulous, and all his friends and relations who read these notes. In the present instance, the merry old arab ought to jump for sheer joy, because the top clacks are the real McCoy on this engine. Those on the full-sized *Britannias* follow Southern practice,

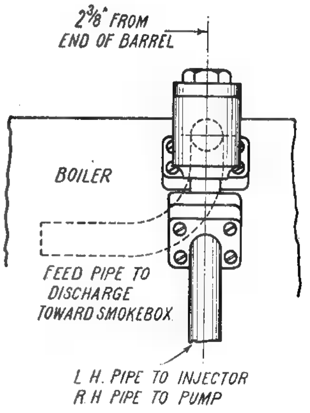


Section of clackbox with flange joints

but they would need special cored castings if reproduced to [illegible] pattern in the small size ; and to save trouble and expense, I have schemed out an easy method of building them up, which you can see in the reproduced drawings. The finished clackboxes, if used with square pipe flanges bear a family likeness to the full-sized ones ; and for those who are not so particular, and would rather use a spanner than fiddle about with weeny screws, there is an alternative shown, with a union instead of a flange connection. Being terribly lazy, and not caring a brass button for the worthy Inspector, I'm using unions!!

Clackboxes

The clackboxes can be made from drawn or cast bronze or gunmetal rod of ⅜ in. diameter. Chuck in three-jaw, and turn down about 1¼ in. length to 11/32 in. diameter ; part off two ½ in. full lengths. Rechuck one, face the end, centre, and drill right through with No. 34 drill. Open out and bottom to 5/16 in. depth with 7/32 in. drill and D-bit, tap ¼ in. × 40 for about 3/16 in. down, and slightly countersink the end. Poke a ⅛-in. parallel reamer through the remains of the No. 34 hole. Reverse in chuck, counterbore the hole for 1/16 in. depth with No. 23 drill, only going deep enough to allow the end of a piece of 5/32-in. pipe to enter ; chamfer off the outside, for appearance sake, as shown. Drill a No. 23 hole in the side, at 3/16 in. from the top. In this, fit a piece of 5/32-in. copper tube about 1½ in. long. Fit another piece (any odd bit will do) into the bottom of the clackbox, and silver-solder both. After pickling and washing off, bend the bit at the bottom of the clackbox, to the curve shown, and cut off to length ; leave the other bit straight, for the time being. A 5/32-in. ball, either rustless steel or phosphor-bronze, can be seated in the box by the usual "hammer-and-plonk" antic, so often described in these notes, and a cap made from the ⅜-in. rod ; a kiddy's practice job needing no detailing out. The ball should have a full 1/32 in. lift on the pump side, and about 3/64 in. on the injector side. Tip : if you aren't handy at filing true hexagons, drill a 1/16-in. hole in the middle of the cap, after turning down and screwing it, and part off at 1/16 in. from the shoulder. Chuck a bit of ¼-in. hexagon rod in the three-jaw, and turn a pip on the end, to fit the hole in the cap tightly. Part off at a full 3/32 in. from the shoulder ; reverse in chuck, and chamfer the corners. Squeeze the pip into the hole, and silver-solder it in, doing the job upside down, and dropping a tiny spot of silver-solder into the hole. The result will be a delightful little hexagon head with-

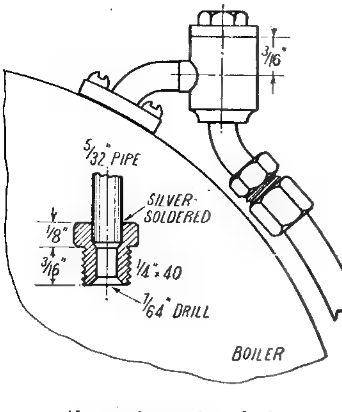


Left-hand clackbox erected

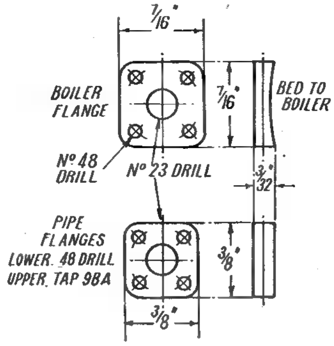
out the trouble of filing it, the joint being invisible.

Flanges

The flanges are cut from 3/32-in. sheet brass, a simple matter of sawing, filing, and drilling for screw and pipe holes. Note—drill both the pipe flanges with No. 53 drill, either clamped together, or drilling one and using it as a jig to drill the other. Tap the holes in one with 9-B.A. tap, and open out the holes in the other, with No. 48 drill. The boiler flange is drilled No. 48 ; don't forget to bed this one to the curve of the boiler. It is then put on to the pipe in the side of the



Alternative union fitting



Flanges

clackbox, in the position shown in the drawing; the smaller flange, with the tapped holes in it, is fitted to the pipe underneath the clackbox. Both flanges are then silver-soldered to the pipes. It is advisable to remove the balls and caps whilst this is being done, as the clackboxes are sure to become pretty hot. Pickle and wash off; then bend the pipes to the curves shown in the illustrations. The pipe leading from the side of the clackbox, is bent, below the flange, so as to discharge the water toward the front end of the boiler barrel; that means that one of the pipes must have a left-hand bend, and the other one, a right-hand bend, when looking at the clacks on the side to which the pipes are attached. The clack with the bigger lift on the ball, goes on the left side of the boiler, and delivers the feed from the injector; the smaller-lift one, attends to the feed from the pump. Don't bother yet about fitting pieces of pipe to the other two flanges with the No. 48 clearing holes in them, as the boiler must be erected before ascertaining the lengths of pipe needed, to connect up with pump and injector.

Builders who prefer the union connections for the pipes, instead of flanges, just chuck a bit of $\frac{5}{16}$ in. hexagon rod in the three-jaw. Face, centre deeply with letter E centre-drill, drill down about $\frac{3}{8}$ in. depth with 7/64-in. or No. 36 drill, turn down $\frac{3}{16}$ in. of the outside to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. $\times$ 40. Part off at $\frac{5}{16}$ in. from the end. Reverse in chuck, chamfer the corners of the hexagon, counterbore for a bare $\frac{1}{8}$ in. depth with No. 23 drill, and fit the piece to the pipe underneath the clackbox, as shown, in place of the $\frac{3}{8}$ in. square flange, silver-soldering the joint; see alternative drawing.

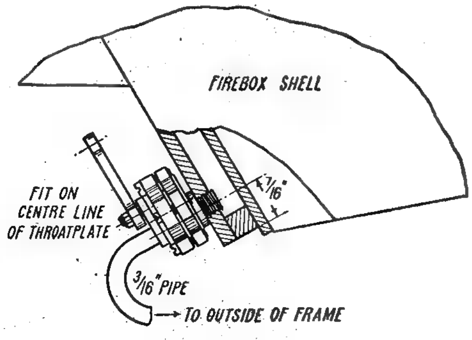
How to Erect the Clackboxes

At $2\frac{3}{8}$ in. from the front end of the boiler barrel, and $1\frac{1}{8}$ in. from each side of the top centre line, drill a 5/32-in. clearing hole. No. 21 drill is the correct size, but the hole may have to be made a shade larger to allow the bend in the pipe to enter. Put the pipe through, with the end of the bend pointing toward the smokebox tubeplate, and see that the flange beds down nicely on the boiler barrel. Run the 48 drill through the screwholes in the flange, making countersinks on the boiler barrel; follow with No. 53, and tap 9 B.A. Wet the tap with cutting oil, for clean threads, and to prevent the soft copper choking the tap flutes. Remove clack assembly, punch a 5/32-in. hole in a bit of 1/32-in. Hallite or similar jointing, a little bigger than the flange, put this over the pipe, replace clack assembly and secure with four 9-B.A. home-made bronze screws, which may have round or hexagon heads, just as you fancy. The bit of jointing may then be trimmed off close to the flange, by aid of a sharp pocket-knife, or a discarded safety-razor blade. By using a larger piece of jointing than is required, and trimming to size afterwards, what I call "tightening-down splits" in weeny jointing gaskets are avoided.

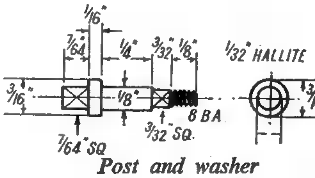
If by any mischance, the flange doesn't bed nicely to the boiler, and the gasket is not held down tightly all over the flange area, don't worry! Leave out the gasket altogether, screw down the flange as tight as it will go, without stripping the screw threads or beheading the screws, and sweat all over the flange and screw-heads with ordinary soft solder, same as sweating stay-heads. This will effectually seal the joint; and as the clackbox will probably never need removing during the lifetime of the engine (it can be cleaned in place) there is nothing to lose any sleep over.

"Everlasting" Blowdown Valve

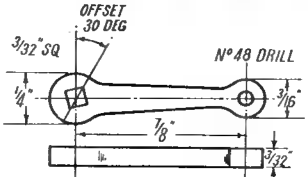
In my notes last week, I mentioned that I would be specifying an "Everlasting" blowdown valve, as used on the full-sized engines, and



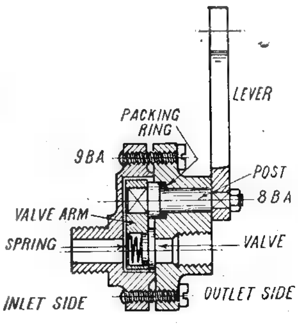
How to erect blowdown valve



Post and washer



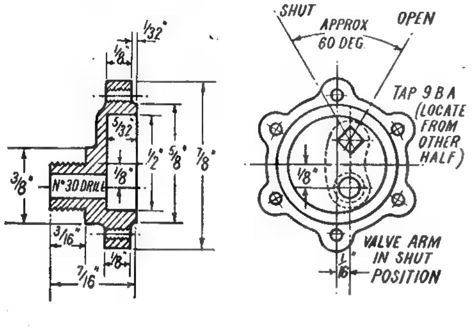
Lever



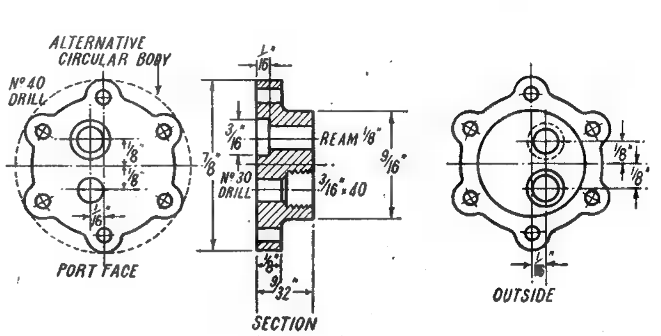
Section of "Everlasting" blowdown valve

compared it with the screwdown types. As it is [redacted] long time since I gave details of this type of valve, for *Maid of Kent*, *Minx* and *Doris*, I have drawn out [redacted] valve suitable for *Britannia* which differs slightly in detail ; and [redacted] study of the accompanying illustrations will [redacted] once show its superiority over the screw type, especially those involving drilled and tapped holes in [redacted] copper foundation ring. It should make which operates [redacted] arm inside the recess ; and as the arm carries the valve, [redacted] slight movement of the handle causes the arm to slide the valve off the port, allowing the water (and any sludge or other residue in it) to blow clean through the valve, without having to negotiate any corners. Another slight movement of the handle, closes the valve, steam and water-tight. Rather [redacted] different proposition to trying to diameter, and screw ¼ in. × 40. If castings [redacted] available, they will be of the correct shape, and there won't be all this fallal to bother about. Never mind about the holes for the screws yet, nor filing the outside to shape as shown.

Chuck the bit of rod again, face off truly, and turn down 5/32 in. length to $\frac{3}{16}$ in. diameter. Part off at $\frac{5}{16}$ in. from the end ; reverse in chuck, and take [redacted] 1/32-in. skim off the face, to



Inlet half of valve body



Outlet side of valve body

Inspector Meticulous once again cheer long and loudly ! This particular valve is made with [redacted] screwed spigot, which fits into a tapped hole in the middle of the throatplate, just above the front section of the foundation ring. A $\frac{3}{16}$-in. pipe is screwed into the outlet, and bent so that the sludge is discharged either at the side or back of the engine ; [redacted] rod for operating the handle, [redacted] be fitted to same when the boiler is erected, and [redacted] slight pull on this, gives an instantaneous full-bore blowdown. No long threaded spindle to become choked up with scale and dirt, and no right-angle bends to act [redacted] traps for the residue.

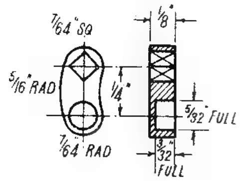
For the benefit of readers who [redacted] no acquainted with the "Everlasting" blowdown valve, I might briefly repeat that it is about the most trouble-free gadget of its kind ever used in full-size practice ; and [redacted] widely used in this country, U.S.A. and other parts of the world. It provides one of those few instances where a little copy of the full-sized article can be made to work satisfactorily without modifications, the [redacted] being, the simplicity and reliability of the big one. The valve body is made in two halves, [redacted] which forms a portface. The other half is recessed, to carry the valve and operating arm. Normally, the circular valve covers the port, and the full pressure of the boiler keeps the valve tight against the portface. The handle is attached to [redacted] spindle, close [redacted] screw valve with the body of [redacted] full of grits and scale, which stops the pin from seating properly.

Valve Body

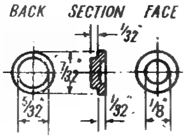
Maybe our approved advertisers will supply little castings for the valve body. If not, ⅞ in. rod material can be used. Make the recessed half first ; this is the inlet side. Chuck [redacted] short bit of rod in the three-jaw ; face off, and form a recess ½ in. diameter and 5/32 in. deep, with [redacted] ½-in. D-bit, held in tailstock chuck. This is the easiest and quickest way, though some folk may prefer "boring technique." Now cut back the face very slightly, so [redacted] to leave [redacted] ring, [redacted] bare ⅝ in. diameter, around the hole (see section). This ring forms a steam and water-tight joint with the portface. Part off at $\frac{7}{16}$ in. from the end ; reverse in chuck, and turn down a bare 9/32 in. length to ⅝ in. diameter. Use [redacted] tool with [redacted] rounded-off tip, so [redacted] to leave a radius at the end of the cut.

The parting tool should have left the true centre [redacted] the piece of metal. At ⅛ in. from this, make [redacted] centre-pop and chuck the piece in the four-jaw with the pop-mark running truly. Open it out with a centre-drill, and drill right through into the recess, with No. 30 drill. Turn down [redacted] bare ½ in. length to ⅜ in. diameter, using the rounded-off tool again ; then, with an ordinary knife-tool, turn down [redacted] bare $\frac{3}{16}$ in. length to ¼ in. true it up. The tool again will indicate true centre ; and through this, scribe a line right across the face, also another, parallel to it, but $\frac{1}{16}$ in. away. Scribe another line at right-angles to the first one. On the off-centre line, at ⅛ in. above and below the horizontal line, make two centre-pops. Chuck in four-jaw with the upper one running truly ; open the pop-mark with [redacted] centre-drill, and drill through with No. 34 drill. Counterbore with [redacted] $\frac{3}{16}$-in. D-bit to $\frac{1}{16}$ in. depth, and poke a ⅛-in. parallel reamer through the rest of the hole. Rechuck with the lower mark running truly, open the centre, and drill through with No. 30 drill. Remove from chuck, open out the other side of the hole for ⅛ in. depth with 5/32-in. drill, and tap $\frac{3}{16}$ in. × 40.

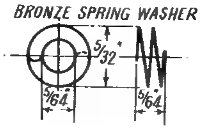
Now, on a circle 23/32 in. diameter (5/64 in. from the edge) set out and drill the six No. 48 holes for the screws. Put the two halves of the valve body together in such a position that the No. 30 holes line up [redacted] done in two wags of [redacted] dog's tail, by putting the No. 30 drill through the two holes, lining up the two halves of the body with the drill in position, and putting [redacted] toolmaker's cramp over them. Run the No. 48 drill through the holes in the drilled half, making countersinks on the undrilled half ; follow with No. 53, and tap 9 B.A. Put the [redacted] in temporarily (steel screws, any heads you fancy) and remove the cramp ; then, if you aren't [redacted] lazy [redacted] I am, file out the



Valve arm



Valve



Valve spring

metal between the screws, and make the whole doings look pretty, as per the illustrations. If you *are* lazy, leave the body circular; it doesn't make a farthingsworth of difference to the working of the valve, and as it is hidden between the frames, behind the trailing coupled axle, nobody will be any the wiser. What the eye doesn't see, the heart doesn't grieve over!

Valve and Arm

On a bit of $\frac{1}{8}$-in. brass plate about $\frac{1}{2}$ in. long and $\frac{5}{16}$ in. wide, scribe a line down the middle; and on this, make two centre-pops $\frac{1}{4}$ in. apart. Drill the top one right through with a 7/64-in. or No. 36 drill, and either file the hole square, or drive a square punch through it. The latter could be made from a bit of $\frac{1}{8}$-in. square silver-steel, as quickly as most folk could file the hole, and is useful for other things; I keep a collection of various sizes. Drill the other pop-mark a little way in, with a 5/32-in. drill, and finish with a 5/32-in. D-bit to 3/32 in. full depth; watch your step here, as there is very little metal to play with. Finally, file the piece to the outline shown around the holes.

To make the valve, chuck a piece of $\frac{1}{4}$-in. round bronze rod in three-jaw; turn down $\frac{1}{8}$ in. or so, to 7/32 in. diameter, face the end, and cut a recess 1/32 in. deep, in the face, with a $\frac{1}{8}$-in. D-bit. The exact diameter doesn't matter; it is only a clearance recess, to help the valve to keep a true face. At 1/32 in. from the face, run in a parting-tool, until the rod is a bare 5/32 in. diameter; then part off at $\frac{1}{16}$ in. from the face. The 5/32 in part should be an easy fit in the recess in the valve arm.

Lever and Post or Spindle

The lever is filed up from a bit of $\frac{1}{4}$ in. × 3/32 in. mild-steel strip, just like a lever or link in the valve gear; the illustration gives dimensions. The small boss is drilled No. 48, and the larger one 3/32 in. or No. 42, the hole being filed or punched square. Note that the square is set over approximately 30 deg.; this to give the lever an equal movement each side of the vertical position, when the valve is shut or fully open, as shown diagrammatically on the illustration of the inlet half of the valve body.

The spindle, or post, as the makers of the full-sized valves call it, is turned from $\frac{1}{4}$ in. round bronze or rustless-steel rod, held in three-jaw. Face the end, and turn down the first $\frac{1}{8}$ in. to a bare 3/32 in. diameter, screwing it 8 B.A. Next, turn down 11/32 in. length to $\frac{1}{8}$ in. diameter, an exact sliding fit in the $\frac{1}{8}$-in. reamed hole in the outlet side of the valve body. Push the rod back into the chuck until only 3/32 in. of this turned part is projecting from the jaws, and file it to a 3/32-in. square, using the chuck jaws as a guide, as I have described "many times and oft." Pull it out again, turn down about $\frac{1}{4}$ in. to $\frac{3}{16}$ in. diameter, and part off at a bare $\frac{3}{16}$ in. from the shoulder. Reverse in chuck, and file a square on the end, 7/64 in. long, to fit nicely in the square hole in the valve arm. Line up the two squares on the post, or the lever will be all cockeyed when the valve is assembled.

Face the two halves of the body (portface and ring) also the valve, exactly as I have decribed umpteen times for cylinder portfaces and slide valves, by rubbing on a piece of fine emery or other abrasive cloth, laid business side up on something dead flat. Put a washer of 1/32-in. Hallite, or similar jointing, made to size shown, on the post behind the collar; push the post through the hole in the valve body (see assembly section) so that the washer and collar enter the counterbore. Put on the lever, and secure with a nut. Put a small bronze spring washer of the kind shown (commercial article, used in many Milly-Amp fittings) in the recess in the valve arm, and put the spigot of the valve in the recess over the spring; then place the arm in position, with the square on the post entering the square in the arm. Put a smear of plumber's jointing around the faced part of the ring on the other half of the body, put the two halves together, secure with the six screws, and Bob's your uncle once more. If the lever doesn't move equally both sides of the vertical position, you have got it on the wrong side out, as the kiddies would say; turn it over.

All that is needed to erect, is to drill a 7/32-in. hole in the centre of the throatplate, $\frac{7}{16}$ in. from the bottom, and screw in the spigot of the valve, with a taste of plumbers' jointing on the threads. The lever should be at or near the top; the pipe can wait until the boiler is erected, which can be done after we fit the grate and ashpan.

BRITISH CRAMPTON LOCOMOTIVES

(*Continued from page* 496)

leading axle to intermediate was 6 ft. 6 in.; intermediate to driving, 6 ft. 9 in., total 13 ft. 3 in. Overhang of frames, at leading end 3 ft. 3 in., at trailing end 4 ft. 3 in. Boiler centre height above the rails is 4 ft. 7 in.

The amount of heating surface is unknown to the writer but as there were, through the boiler, no less than 196 tubes of 1.875 in. diameter, by approximately eleven feet long the tubes must have yielded about 1,058 square feet; whilst the firebox would doubtless contribute a further 78 sq. ft., making a total (assumed) of 1,136 sq. ft. The working pressure was 90 lb. per sq. in.

This engine would undoubtedly turn the scale at well over the weight of the Tulk and Ley seven-feet engines and had a much higher tractive effort, due to the higher boiler pressure; but the *Courier* was nevertheless a light engine, and must have proved in a short time, incapable of handling the ever increasing weight of trains on the Northern Division of the North Western main lines. Mr. C. Hamilton Ellis, in his book, *Some Classic Locomotives*, says: "Poor little *Courier* does not seem to have been a frantic success; she was certainly not so good an engine as the *London*. Allan was naturally inclined to favour his own design and his preferences were probably weighted in advance in favour of his synthetic Crampton engine."

IN THE WORKSHOP

BY DUPLEX

AN ELECTRIC MUFFLE FURNACE

As shown in Fig. 2 in the previous article, the ends of the heating coil lying outside the covering of insulating material are protected with ceramic insulating beads, and the free ends of the wires are connected to the two plugs carried in the backplate of the casing. To insulate these plug connectors, the backplate is fitted with double bushings made of Mycalex; this material is an excellent insulator and can be easily machined. In an electrical appliance of this kind, it is essential for safe working to fit an effective earthing connection to the metal casing. For this purpose, as illustrated in Fig. 11, two brass angle-pieces are secured to the backplate, so as to make contact with the spring earthing strips fitted to the socket carrying the current from the mains. These spring contacts are, in turn, connected to the third or earthing wire of the supply cable.

Concluded from page 449, April 9, 1953.

Finishing the Casing

The panels forming the top, bottom, and two sides of the casing are cut out from sheet-iron to the dimensions given in Fig. 12. After removing the backplate, the top and the two sides of the casing are slid into position under the four angle-strips, but the bottom plate is not fitted at this stage, as it will be secured in place with screws after the casing has been finally packed with insulating material.

The Insulating Packing

In order to prevent the dissipation to the casing of the heat generated in the wire element, and to concentrate it in the muffle, the casing is packed with special insulating material. Kayex Vermiculite No. 3 was used, as its insulating properties are high for both heat and electricity.

This material, manufactured by Vermiculite Ltd., 74, Cheapside, London, E.C.2, is a mica-like mineral substance in granular form, and it can usually be bought at shops supplying gardening requisites. With the furnace placed bottom uppermost, the Vermiculite is packed loosely into the casing so as to fill completely the space between the muffle and the surrounding walls.

When the bottom panel has been secured in place with screws, the furnace can be connected to the mains and given a trial run, but for regular use it is advisable to fit some form of control device for maintaining a constant temperature.

In the event of the heating coil burning out after long service, the muffle can be rewound without much difficulty by first removing the bottom panel and emptying out the Vermiculite; the muffle is then detached and the insulating covering broken off.

The Control Unit

This is the same as that used for controlling the small furnace, described in a previous article, and consists of a Simmerstat thermo-switch for shutting off the current.

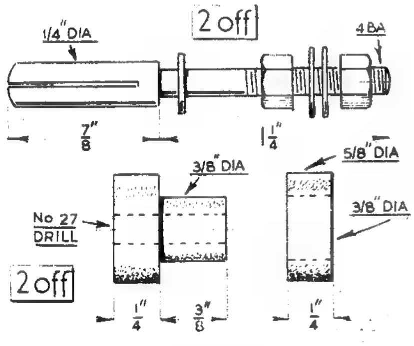
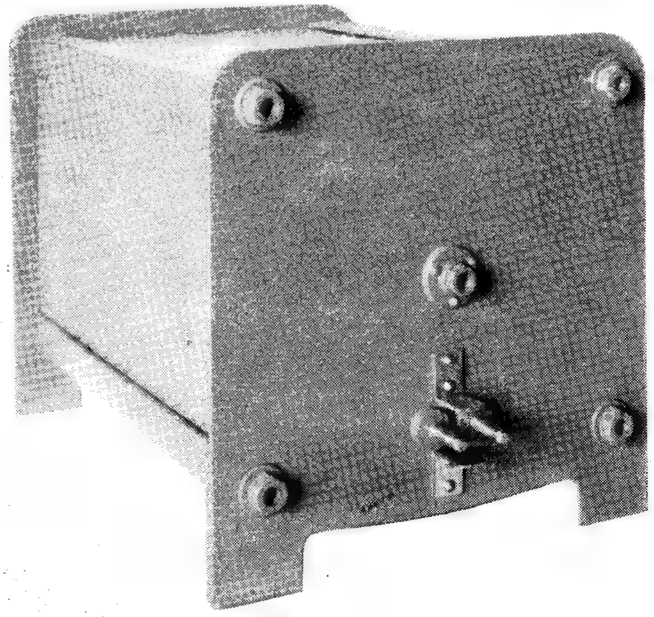


Fig. 10. The plug connectors and Mycalex bushings



Right—Fig. 11. Showing the plug connectors and earthing plates fitted to the back of the furnace

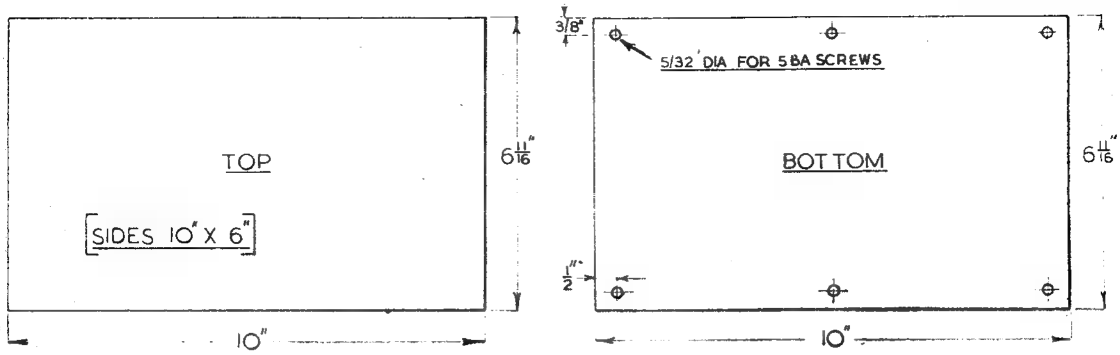


Fig. 12. The top, bottom, and side panels

This switch is furnished with a control knob for adjusting the duration of the current flow. As both the thermostat of the switch and the heating coil of the muffle are affected equally by any variation of the supply voltage, fluctuations of the public electricity supply do not materially interfere with the working of the furnace. In practice, no difficulty has been found in maintaining the temperature at a reasonably constant level.

Estimation of Temperature

The following colour changes are given as a guide for the visual estimation of temperature, but it must be borne in mind that a piece of hot metal that looks bright red, when seen in a darkened room, may appear in sunlight hardly to glow at all. This may possibly have given rise to the belief that sunlight puts out a fire.

Dark red 700 deg. C.
Cherry red 790 deg. C.
Bright cherry 970 deg. C.
Light orange 1,080 deg. C.

The Pyrometer

Two thermo-electric effects are commonly utilised in the construction of pyrometers. In the first, the rise of the electrical resistance of a coil of wire, as the temperature is increased, is measured by means of a galvanometer and a small battery. But the difficulty here is that the readings will vary with any change of the battery voltage, unless a Wheatstone bridge is employed and the circuit is balanced before taking a reading. The second method, and the one adopted, is to connect a thermo-electric couple to a sensitive measuring instrument. The underlying principle is that, when the junction of two dissimilar metals is heated, a difference of electrical potential is set up in the two connecting leads forming the cold junction. With a pyrometer made in the workshop on these lines, no very accurate recording of temperature was expected, nor is this claimed for the instrument described, but the meter readings appear to be sufficiently exact to serve as a guide for controlling the temperature when hardening or case-hardening steel components.

Making the Pyrometer

The method of construction is illustrated in Fig. 14. The wires, representing the two dissimilar metals, are 14-s.w.g. nickel and a strip of 14-s.w.g. copper beaten into a hollow curve to enable it to be passed between the inner quartz tube and the outer tubular-steel casing. Metal wires specially produced for making pyrometer elements can be obtained, and these would probably serve better, as they are highly resistant to oxidation and exhibit a greater potential difference.

The wires are twisted together and the coil formed is compressed in the vice until the two metals are, to all intents and purposes, welded together and intimate contact is made at the joint.

Commercially, the joint is sometimes made by electrically welding the two wires. The free ends of the wires are connected to terminals

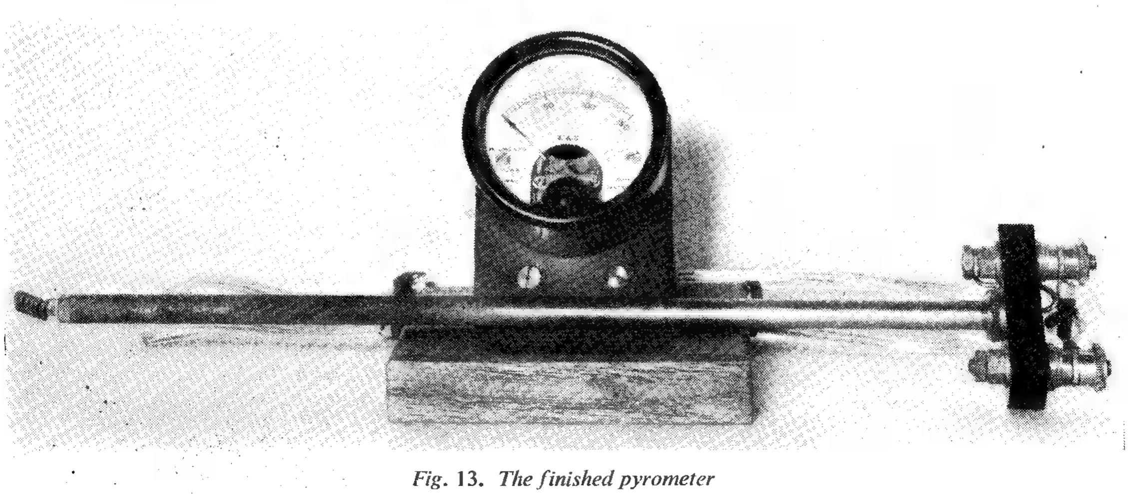


Fig. 13. The finished pyrometer

carried in a block of insulating material, and the leads from the terminals carry split plugs for connecting to the sockets fitted to the meter.

The Meter

Pyrometers usually have a millivoltmeter for recording the difference of potential at the cold ends of the wiring; but rather than buy a special meter, one of the many war-surplus instruments that happened to be in the workshop was used as an experiment. This meter is a volt-

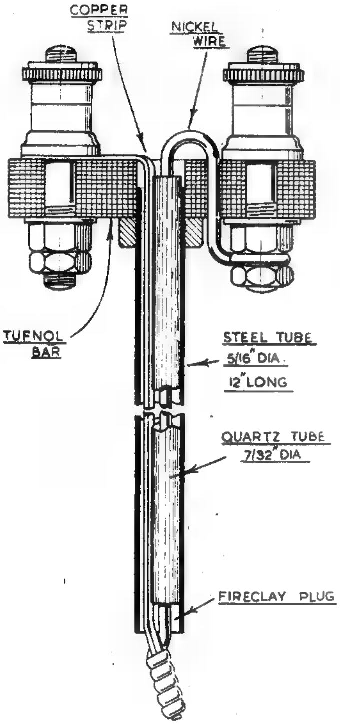


Fig. 14. Constructional details of the pyrometer

meter reading to 150 V, d.c. and had a resistance of 30,000 ohms connected in series with the moving coil. With the resistance removed, it was found that a full-scale reading was obtained when the pyrometer coil was heated in the flame of a Bunsen burner.

Calibrating the Meter

The next step was to calibrate the meter to give approximate readings in degrees centigrade. For this purpose, the melting points of chemically-pure samples of bismuth, lead, and zinc were used for obtaining three datum points on the metre scale. These metals have melting

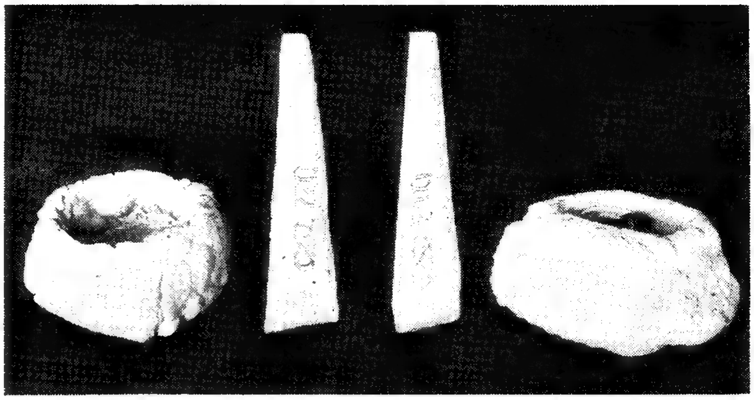


Fig. 15. The fire-clay crucibles and two Seger cones

points of approximately 270 deg. C., 328 deg. C., and 420 deg. C. respectively.

The metal samples were melted over a Bunsen burner in small crucibles made of fire clay, and the coil alone of the pyrometer was immersed in the metal as soon as it had become molten. As the scale reading on the meter with molten bismuth was much too high for the higher melting points of other metals to be recorded, a shunt made of resistance wire was connected across the meter terminals. The length of the shunt wire was next adjusted until the meter read 27 for the 270 deg. C. melting point of the metal.

It was then found that the meter read correctly for the melting points of lead and zinc. On plotting a graph showing the meter readings against the known melting points, the points of intersection fell on a straight line, and it was assumed, therefore, that readings for higher temperatures could be plotted by producing this line. As a check on the calibration, or as an alternative method, Seger cones can be used to indicate the temperature within the furnace. These cones, manufactured by Messrs. Wengers Ltd., Etruria, Stoke-on-Trent, are made of material that softens at a critical temperature, and the end-point is taken when the tip of the cone droops. For calibration at the higher temperatures, the cones used indicated temperatures, approximately in hundreds of degrees, rising from 600 deg. C. to 1,000 deg. C., and it was found that the indicated temperatures corresponded closely with those recorded on the plotted meter scale.

To enable the pyrometer to be inserted into the interior of the muffle, the inspection window in the fire door was fitted with the spectacle plate illustrated in Fig. 16; the plate hangs vertically from its pivot so as to shut automatically when the

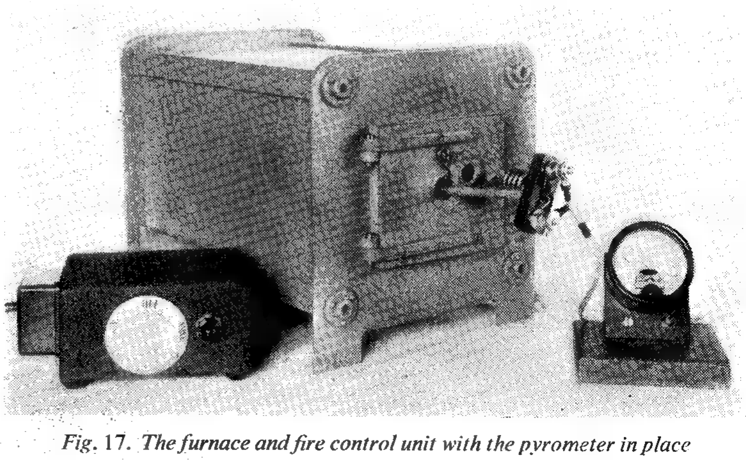


Fig. 17. The furnace and fire control unit with the pyrometer in place

pyrometer is withdrawn. The complete furnace with its pyrometer and control units is shown in Fig. 17.

Case-hardening

As [redacted] constant, specified temperature can be maintained, the furnace is well suited for case-hardening small parts. To ensure that the heating coil is not affected by chemical action, bone dust is used as the case-hardening medium, instead of [redacted] of the quick-acting, commercial compounds.

Bone dust is largely used in the gunmaking trade for this purpose, [redacted] it is very important to avoid corrosion or distortion in the closely-fitted and finely-engraved breech parts and lock plates.

Bone dust has the further advantage that case-hardened parts are left with [redacted] elegant mottled finish showing a good play of colours.

Before being used, the bone dust is parched at [redacted] low temperature until it has the appearance of ground coffee.

The case-hardening is best carried out in an iron pot fitted with [redacted] loose lid, and the electric switch casing, illustrated in Fig. 18, forms [redacted] convenient receptacle. A short length of conduit is screwed into the casing to provide [redacted] hold for the tongs when removing the pot from the furnace.

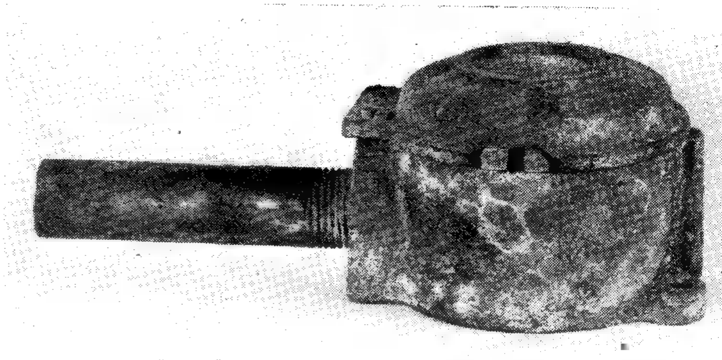


Fig. 18. A case-hardening pot made from a switch casing

Worm-Red

When charging the pot, the individual work-pieces should be everywhere surrounded by a layer of bone dust. After the pot with its contents has been placed in the furnace, the temperature is slowly raised to [redacted] cherry red, corresponding to [redacted] temperature of about 800 deg. C. The old-time gunmakers, of course, judged the correct temperature by eye, and they described this as worm-red. One and [redacted] half hours treatment at this temperature will usually suffice for [redacted] penetration of several thousandths of an inch, but this will depend in part on the composition of the steel. If holes are drilled in the lid of the pot, test rods, made of the [redacted] material as the work-piece, can be treated at the same time. The rods [redacted] then removed at intervals and broken in the vice to show the depth of case reached.

At the end of the heating period, the pot is removed from the furnace with [redacted] pair of tongs or large pliers, and the contents are at once tipped into a bucket of clean cold water.

When hardening the camshaft of the model loco., L.M.S. "-1831," described in this journal by Mr. E. T. Westbury some years ago, the shaft was enclosed in [redacted] length of conduit with the cap at one end loosely fitted in place. After heating in bone dust for one and a half hours, the shaft was tipped on end into cold water.

As was expected, [redacted] slight distortion of the long, slender shaft had to be corrected, but the hardening [redacted] quite satisfactory and the machined surfaces were unmarked except for the mottled finish.

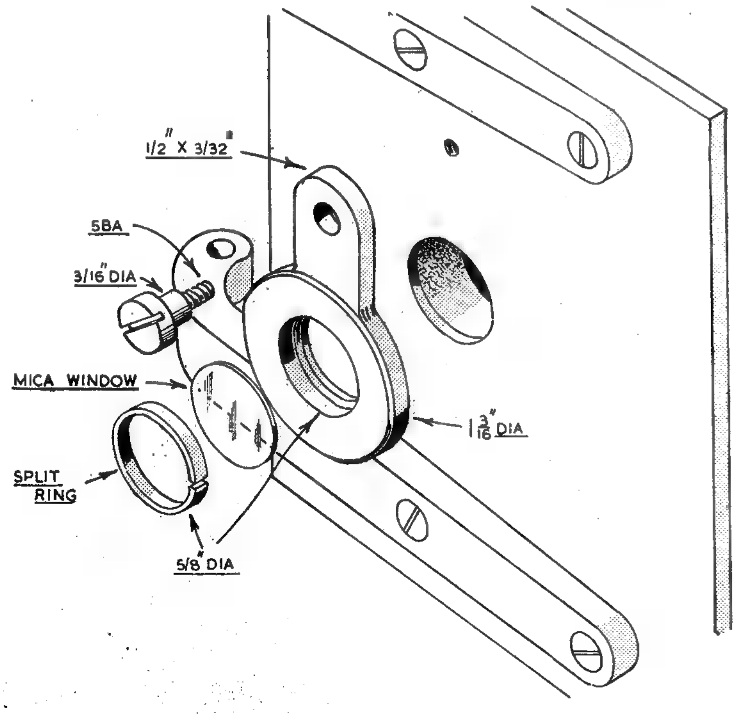


Fig. 16. The fire door fitted with a hinged spectacle plate

Hardening Silver-steel Parts

Silver-steel can often be used in the workshop for making small tools, such as fly-cutters and punches, and this material will take a keen edge after being hardened. The manufacturers recommend that the steel should be raised slowly to the hardening temperature in [redacted] muffle.

When the work is to be quenched in water, 750 deg. C. to 770 deg. C. is given as the hardening temperature, and this is raised to 770 deg. C. to 790 deg. C. for quenching in oil.

A 35 mm. CAMERA and FLASHGUN

By G. Pratt

THE requirements for lens and shutter mounting are rigidity with [redacted] smooth focussing movement free from backlash and, as the shutter must remain upright, a simple helical mount is no use.

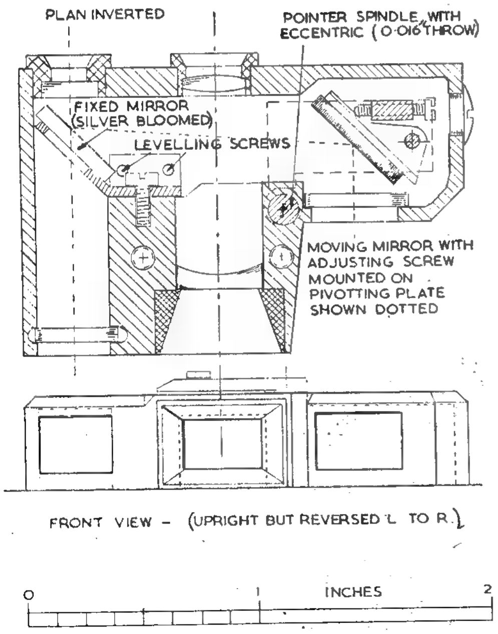
The design, shown in Fig. 5, was worked out to permit straightforward production methods using 2 in. diameter dural bar. The alignment and support of the lens are looked after by the close sliding fit of the front within the rear portion, and the focussing movement obtained from the knurled ring which screws on both. The rear thread is a four-start of 1/6 in. lead and 1/24 in. pitch, right-hand and the front thread single-start 1/24 in. pitch, left-hand. To make the fitting of the threads and plain sliding parts easier, the thread-ring was made first, followed by the rear portion and then the front, as it seems easier to fit a male thread to [redacted] female than vice versa.

Concluded from page 464, *April* 16, 1953.

All important machining was done at one setting in the chuck and little trouble was encountered in getting everything working. After nearly [redacted] year of use, a little play is apparent in the threads but on a lens of only 5 cm. focal length the effect is too small to be noticed. The annular recess beneath the threads was intended to house a spring for taking-up play in the threads but fortunately it has not been needed.

Calibrating the focussing ring was a tiresome business, the "infinity" position being hardest to find on the temporary ground-glass screen, and the divisions were first lightly scratched on. I had found [redacted] formula in a book for calculating the amount of movement required for focussing down to about 2 ft. and I was quite surprised to find that, with one revolution of the ring I could focus from infinity down to 1 ft. 3 in., which is very handy. Before engraving the divisions in the lathe, I used this formula to calculate again the amount of movement needed for each division, but the results still showed more movement that I actually needed. To make [redacted] of these figures, despite the discrepancy, I worked out the circumference of the ring, cut a strip of paper this length, and marked out divisions in proportion to the calculated dimensions. By wrapping this paper strip round the lens mount, I was able to check my scratched divisions, which agreed reasonably well, though on one or two I was obviously astray, and these were corrected. While the ring was back in the lathe for cutting the divisions, the figures were marked with $\frac{1}{16}$-in. punches, using the toolholder as [redacted] jig to keep the figures level and in alignment.

The rear of the mount is tapped to receive two studs, and a set-screw for fixing to the body, and [redacted] small plate on the front of the body carries a pin which, engaging with



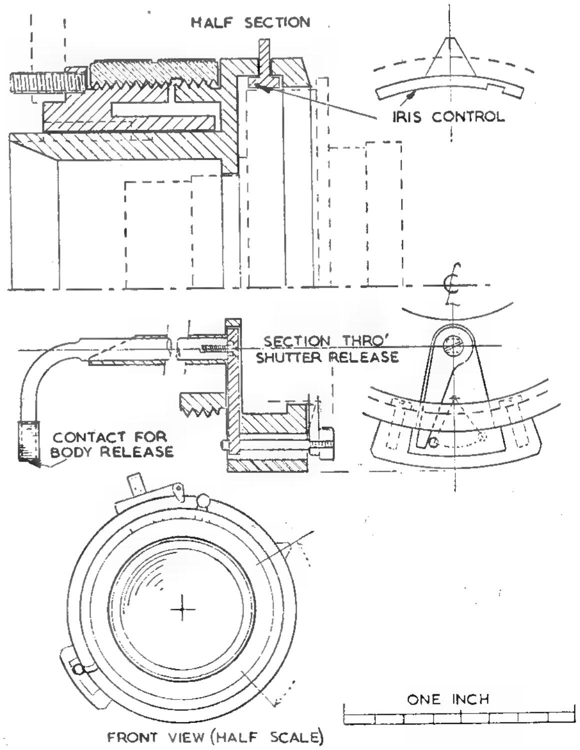


Fig. 4. Range and view-finder

Right—Fig. 5. Details of lens mounting

another at the infinity mark on the ring, prevents the ring making more than one turn, and acts as an index point. The plate is also marked to show the approximate depth of field of focus, at various apertures, against the markings on the focus ring.

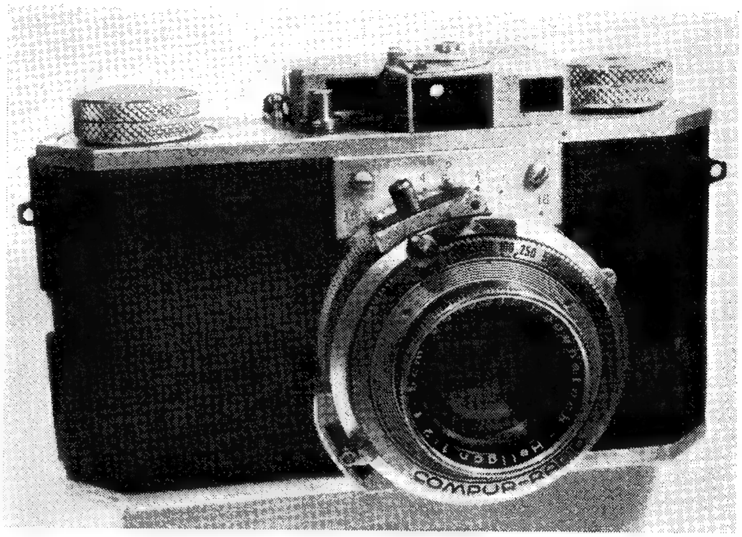
The connection between shutter release and shutter is shown in the additional section on Fig. 5. The 3/32 in. spindle passing through the lens mount is bent at right angles at the inner end, the disc fixed to the end taking the thrust from the bottom of the release. The outer end is squared to 0.070 in. and drilled and tapped 12 B.A. to take a screw to fix the small dural operating lever. The cover at this point prevents accidental movement of the release lever on the shutter body.

As the lens and shutter fit fairly closely within the "hood" formed in the front of the mount, the existing iris control button had to be removed from its flat lever, and a small notch filed to allow this lever to enter the hood and engage in a recess in the small circular piece shown. This has a tongue to project through a slot in the side of the mount for operation of the iris.

As there was no aperture scale with the lens purchased, this had to be calibrated. The aperture diameter of an f.2 lens of 5 cm. focal length is given by dividing the focal length by the "stop" number, i.e. 2.5 cm., but as the light rays converge somewhat between the lens components and as the iris is made to open a little wider than necessary, the f.2 position must be found by looking into the lens from the front, with the rear element removed, and closing the iris until its edge is just becoming visible. The diameter of the opening is now measured, and the iris moved to half this diameter which gives f.4, halving again f.8, f.16 and so on. The diameters at the intermediate stops f.2.8, f.5.6, f.11, and f.22 are calculated to give an *area* of half that at the next larger stop.

The rear flange of the shutter has a small register pin to ensure that it is refitted quite upright, and a special metric thread nut was cut to suit the screw thread which holds the lens and shutter in the mount.

Flashlight work was not considered until the camera had been in use for some time, as the shutter was not fitted with flash contacts. These could have been fitted, but the work costs several pounds, so something had to be done at home. Standard midget flashbulbs require to be fired 20 milliseconds (1/50 sec.) before the shutter is fully open in order that the bulb may warm up to peak intensity, while the "speed midget" type require about 7 millisec. This means that, if the electrical contact is made when the shutter is fully open (as is essential with the "electronic" type of flash) the highest shutter speed to catch the full intensity of a standard bulb is 1/25 sec., or, with a "speed" bulb 1/100 sec., which is not satisfactory for subjects in motion.



Another view of the 35 mm. camera complete

A fully synchronised shutter is provided with a delay mechanism to release the shutter later than the electrical contact but, as this must be accurate to two or three thousandths of a second, it is rather beyond the scope of the average workshop, and I decided to take my contact from the setting lever at the top of the shutter. This lever flies back to its normal position when the shutter is released, and actually moves some ⅜ in. before the shutter is fully open, this part of the movement taking, I understand, five or six milliseconds. By arranging a contact to engage this lever at the start of its travel, the bulb is given a short time to warm up, and I have had excellent results using 1/50 sec. and 1/250 sec. respectively with the two types of bulb.

The construction of the switch is shown in Fig. 6, and something similar could probably be applied to most types of hand-set shutters. One important point is that the spring should not bear on the cam until the lever has been raised clear of the setting knob or the shutter will be seriously slowed down. The spring is solely to act as a stop when moving the contact lever into position after setting the shutter, and to hold the contact up out of the way when not in use. Standard co-axial plugs are 3 mm. o.d. with a 1 mm. centre pin in the flex socket on Compur shutters or 4 mm. o.d. on some other types.

I have dealt with this synchronisation at some length, as I think many readers would find a flash outfit quite handy on various occasions, ranging from club socials or dinners to hunting in dark corners for old traction-engines and the like.

Flashgun

My first flashgun, which is shown in the photograph, and was shown in the Exhibition, suffers from the defects of a first attempt, in being much larger and clumsier than necessary. The drawings show an improved version which I have recently completed, but the construction in both cases is similar.

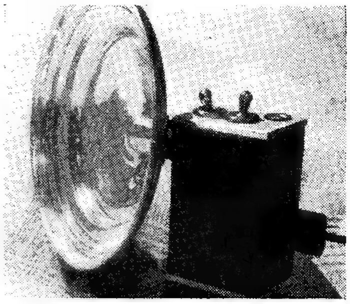
The original is fitted with a 100 mfd. condenser and 30-volt battery, with a two-pin non-reversible plug for the flex lead to the shutter and a miniature screw socket for a lead to a second bulb. It has an on-off switch for the battery (quite unnecessary) and another to short out the extension socket, as this is in series with the bulbholder in the "battery-capacitor" system, which gives more reliable results than a simple low-voltage dry battery circuit.

Fig. 6 shows the electrical connections, and the design of case and bulbholder. The reflector is best made in sheet aluminium (that in the photograph was spun from a

flat saucepan lid) and has [redacted] bush to push over the outside of the bulbholder. The flashgun drawn has no extension socket, and the shutter lead is not detachable. Having disposed of it [redacted] [redacted] Christmas present, I am now working on [redacted] third with a socket on the opposite side to the bulbholder, which will be arranged so that the spring contact will short-circuit on to the socket when the extension plug is withdrawn, so that no switch is needed. The battery circuit is not completed until [redacted] bulb is inserted into the socket, and the condensers should be fully charged in about 10 sec.

The bulbholder and cover is machined and filed from solid dural, being milled out underneath to give more room for connections, and is fixed by two screws inserted from the battery compartment. The bottom plate, of $\frac{1}{16}$ in. dural, has [redacted] piece of thin brass riveted inside to locate it, and part of this is cut and bent up as [redacted] battery contact. The special $\frac{1}{4}$-in. Whit. screw fixing the bottom has a head 18 mm. diameter and 2 mm. thick, to fit the standard accessory shoe found on many

(*Continued on page* 511)



Mr. Pratt's first flasgun

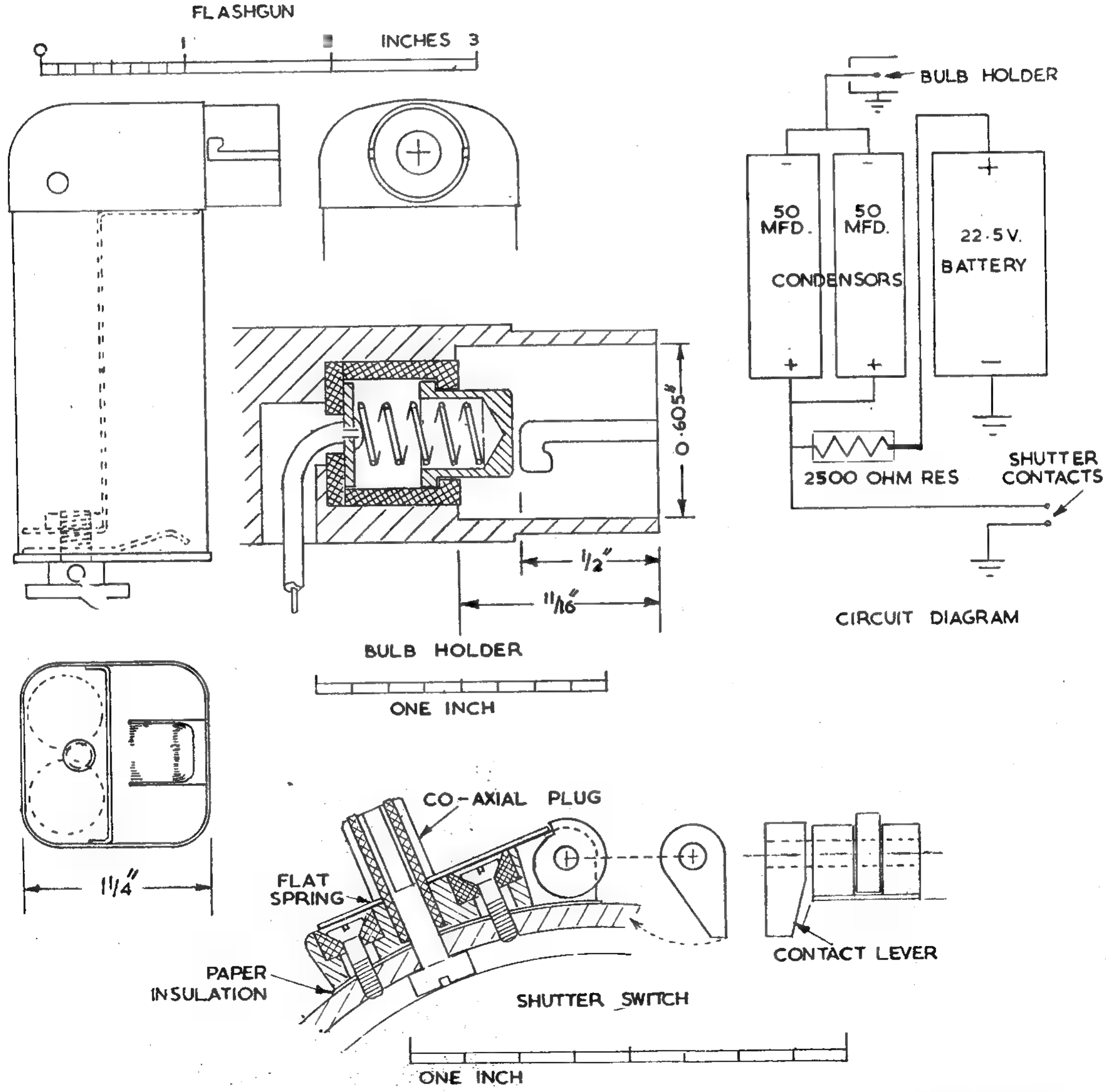


Fig. 6. General arrangement of flashgun with details of bulb holder, shutter contact and circuit diagram

Canadian Locomotive Models

Described by W. J. Hughes

Mrs. Green takes a hand with the $2\frac{1}{2}$ in. gauge "Princess Royal" built by her husband

IN dealing with the Fowler "Big Lion" road locomotive in this journal, I have been assisted greatly by notes and drawings supplied by Mr. S. N. Green, of Calgary, Alberta, [redacted] readers know. But while this road locomotive is Stan's first venture in that particular field, he has been building models for many years, and has sent me a representative selection of photographs of some of them.

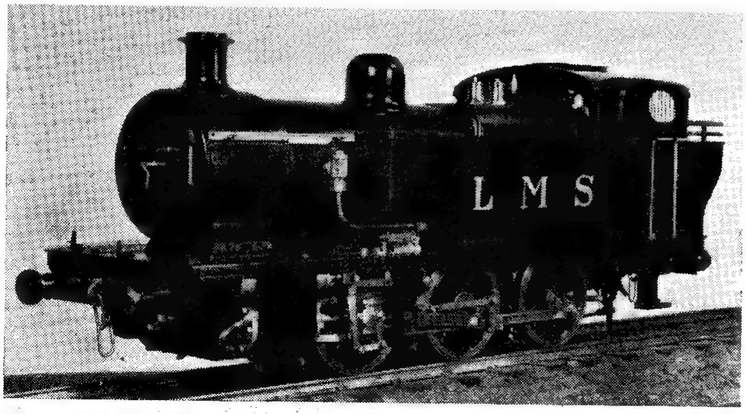
A number of the photographs sent have already appeared in THE MODEL ENGINEER—see Vols. 86 and 87 (1942)—but some of them have not, and so I am submitting them now for the pleasure of readers.

A Dockyard Tank Locomotive

In the issue for April 2nd, 1942, three photographs and [redacted] short note [redacted] published about [redacted] 0-6-0 dockyard tank which was then under construction. This model is based on an L.M.S. dock shunting engine (No. 11270), but the wheel castings were rather over-scale. Despite this, I think it will be agreed that a very nice-looking engine has resulted, with proportions that [redacted] pleasing to the eye. The locomotive was completed in 18 months' spare time work, and the photograph shows the finished engine.

It is built to $2\frac{1}{2}$-in. gauge and 17/32-in. scale, with two cylinders [redacted] in. bore by 1 in. stroke. The diameter of the wheels is $2\frac{1}{2}$ in., and the copper boiler, $2\frac{7}{8}$ in. diameter, contains seven $\frac{3}{8}$-in. tubes and one $\frac{5}{8}$-in. superheater flue. The firegrate is $1\frac{1}{8}$ in. wide and 3 in. long. Fittings include [redacted] $\frac{3}{8}$-in. $\times$ $\frac{1}{2}$-in. hand-pump in the left-hand tank, and hand-operated brakes on the wheels. The locomotive is built to [redacted] outline drawing published in THE MODEL ENGINEER in 1929, and to "L.B.S.C.'s" "words and music."

With [redacted] weight in working order of $21\frac{3}{4}$ lb., the locomotive will walk away with a load on [redacted] flat car of 350 lb., on a working pressure of 75 to 80 lb. Stan says that she is [redacted] bit awkward to keep in steam until the driver gets to know her, but will perform well when he does.



A $2\frac{1}{2}$-in. gauge dockyard shunting locomotive built by S. N. Green, of Calgary, Alberta, Canada

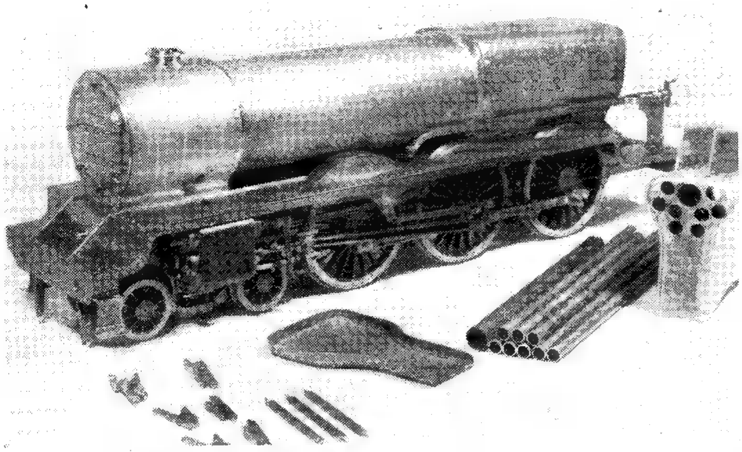
In this connection, he tells of an occasion when she was taken to Winnipeg by one of their "lads." When the latter bought her back, he was very uncomplimentary; said he couldn't get half way round their 600-foot track with her without losing steam. So, without more ado, Stan raised steam in the engine, and did four laps of his own 135-foot track, starting with 60 lb. on the clock and finishing blowing off at 80!

By now, the other fellow's eyes were popping, but Stan took him aboard—total weight 368 lb.—and with [redacted] little slipping in getting away proceeded to do another five laps, only stopping because the tanks were dry.

A "Princess Royal"

A $2\frac{1}{2}$-in. gauge "Princess Royal" was started in September, 1939, and completed in June, 1941; she was illustrated by four photographs in THE MODEL ENGINEER dated April 23rd, 1942. She is still going strong, and the photograph shows Mrs. Green at the controls. This is on [redacted] 30-foot testing track which was installed in the basement for winter use, when the outside temperature was too low for comfort! Now, however, this track is not used, and I have photographs (too small for reproduction) showing the outdoor track in use with [redacted] heavy fall of snow on the ground, and taken in January this year.

The engine is 95 per cent. "L.B.S.C." says Stan, and 5 per cent. his own modifications. There are four cylinders of $\frac{11}{16}$ in. bore and $1\frac{1}{8}$ in. stroke, and the boiler contains eleven $\frac{3}{8}$-in. tubes and



The part-finished " Royal Scot "

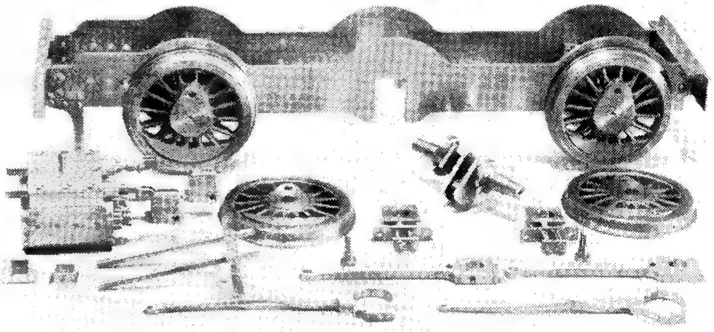
two ¾-in. flues, with [redacted] combustion chamber containing six ½-in. water-tubes. It was tested to 200 lb., and works at 75 to 80.

At one time, because of the difficulty of obtaining suitable coal, Stan fitted an oil-burner. Now, however, he has found some good coal, so the oil-burner has been thrown away. He says " I never did like it, anyway—I like the smell of coal ! " Who doesn't ?

Incidentally, it is worth while looking up that back number to see the other four photographs, especially a close-up of the tender, and another of the complete engine.

A " Royal Scot "

Another photograph shows [redacted] part-finished " Royal Scot " locomotive which was sold, before completion, to " a chap who wouldn't take [redacted] for [redacted] answer." I haven't any particulars of this engine, but if the chap who bought her finished her off [redacted] she was begun, she should be [redacted] grand engine ! She preceded the " Princess," by the way, and [redacted] built following " L.B.S.C.'s " " Olympiade " notes to a large extent.



Chassis for a G.N.R. 0-6-0 *of* 1890, *in course of erection*

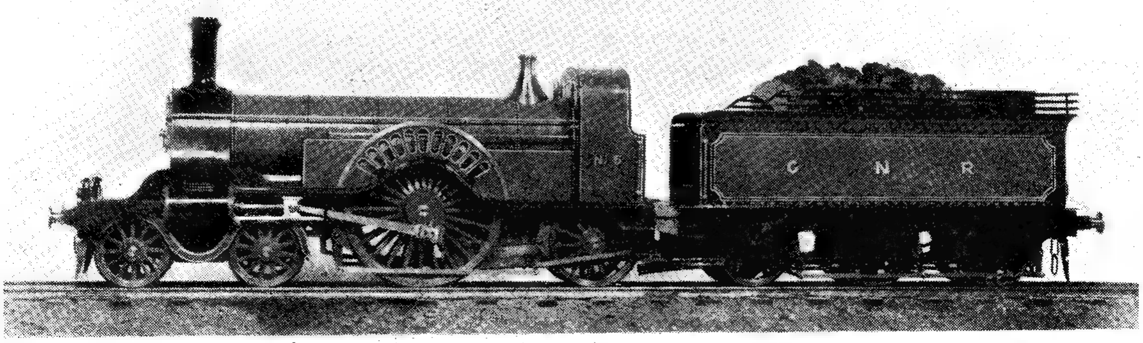
Chassis for a G.N.R. Locomotive

My next photograph shows the parts of [redacted] chassis for [redacted] G.N.R. locomotive of about 1890, during the course of erection. This chassis was built for a friend who, I gather, had no machining facilities, but who finished off the rest of the engine himself. Here again I have no further particulars, but the parts do show the magnificent finish that is characteristic of all Stan's work.

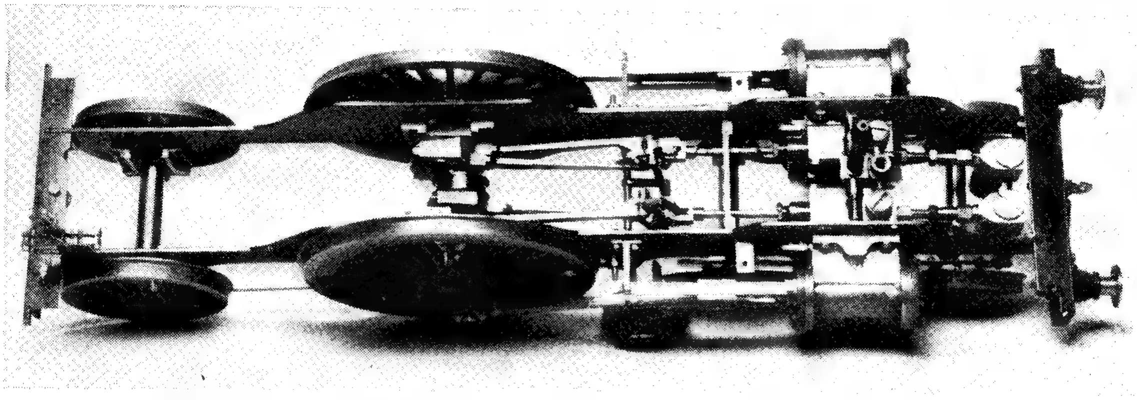
A Stirling Single-Wheeler

But I have saved to the last what is, to me, the *piece de resistance*. One of the prettiest engines of all time was surely Patrick Stirling's 8-foot " single " for the G.N.R., and if Stan Green had built nothing else, his model of this prototype would have earned my admiration.

The engine was built some six years ago for a friend who has [redacted] " scenic " line. It was not designed to do passenger-hauling therefore, but to haul " period " coaches and for show. With regard to the former requirement, she has hauled four period coaches and [redacted] guard's van



Side view of the " scenic " 2½-*in. gauge Stirling* 8-*footer*



Showing the Stephenson link motion

non-stop for 22 laps of a 135-foot track, and with regard to "show," I think the photographs speak for themselves!

The model is built to 17/32-in. scale, for $2\frac{1}{2}$-in. gauge, and the only castings are wheels and cylinders, all other parts being built up. The cylinders are $\frac{5}{8}$ in. bore by $1\frac{1}{4}$ in. stroke, with steam ports 5/64 in. by $\frac{5}{16}$ in. and exhaust ports $\frac{1}{8}$ in. by $\frac{5}{16}$ in. Full Stephenson link-motion is fitted, and gives a cut-off of about 80 per cent. in full gear.

Five 5/32 in. water-tubes are fitted to the Smithies-type boiler, which is $1\frac{3}{4}$ in. dia. copper tube in an external steel casing of scale size. The working pressure is 65 p.s.i., and the boiler is fired by a four-wick spirit-lamp. An axle-driven water-pump was originally fitted—the eccentric can be seen in one of the photographs—but was removed after the first steam tests. It was found difficult to control on a long run, the "driver" not being able to adjust it when running, of course; in any case, it is not necessary, as the tender-mounted hand-pump is used to refill the boiler without letting down steam. The time taken in building was about two years, as it was worked in between other jobs. A lovely job, a credit to her builder, and a source of delight to her owner, of pleasure to you, I'm sure, and of envy to me!

A 35 mm. CAMERA AND FLASHGUN

(*Continued from page* 508)

cameras, but this may be altered to allow a bar fitted to the camera tripod bush to be used instead.

Accessories are far cheaper made at home than purchased, and often more carefully made and convenient in use. The first and most important is a lens hood. Mine was turned from the remainder of the bar used for the lens mount; it is conical in shape (45 deg. included angle) and fitted at the front with a rectangular mask. The rear end is bored out to two diameters, one fitting direct to the outside of the front lens component, and the other to fit over a filter mount. These mounts are very simple, just a ring fitting over the front of the lens, with an internal flange to retain the filter glass, which is fixed with "Bostik."

Another useful item is a cable release (purchased) fitted, to the top of a small thimble which screws over the bush of the shutter release for use in time exposures. For the flashgun, I have an additional reflector and bulbholder for use when two bulbs are required and also, much simpler and more often in use, a length of flex fitted with a plug at each end to insert in the shutter lead, so that the light need not always be mounted on the camera.

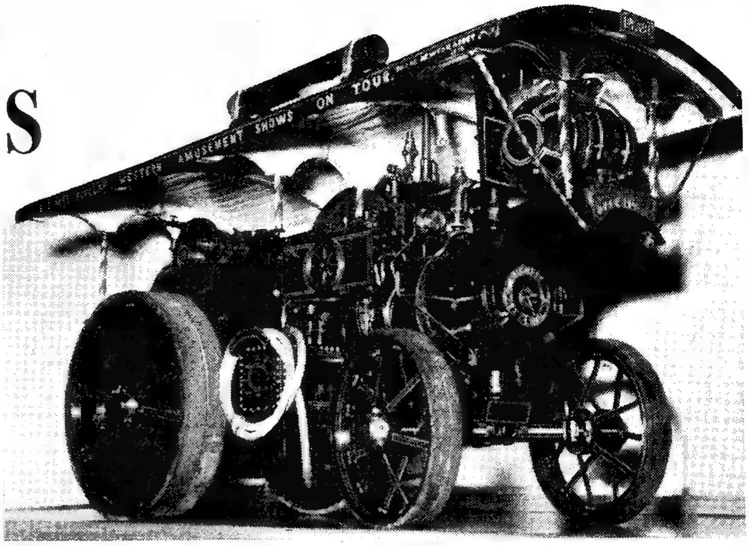
A black leather ever-ready case, lined with tinplate and black velvet, protects the camera from any damage, although it reveals my inexperience of work with needles and awl.

There are a few improvements which I could wish for; it would be an advantage to use a second cassette for the take-up spool, so that a short length of film could be cut and removed for development, without a trip to the darkroom or groping under the bed-clothes. The film pressure plate, at present of polished brass, would be better black, but my attempts at chemical blackening have been quite unsuccessful, and in any case this might soon wear off. I think a hard material is necessary for this plate, as it is better to have any grit embedding itself in the film and scratching the plate than vice-versa, otherwise black plastic might serve.

A coupled rangefinder has already been mentioned, and my only other wish is for a really fast focal-plane shutter. Living away from home, I can normally spend only three or four hours a week in my workshop, and though I think I could make one satisfactorily, and have occasionally sketched out tentative designs, I have no time for the necessary experimental work.

Finally, what have I achieved by making this camera? It has not turned me into a good photographer overnight, but I enjoy using it, and in a few years' time I may perhaps have acquired the skill needed to produce photographs worthy of an exhibition. In the meantime, it is enabling me to do a bit more photography for the same amount of money as I spent previously, when I had a "620" folding camera costing about £7. On the last occasion I took that camera on holiday, I came back with nine exposed films, 72 negatives, for about 30s., including developer. I can now get the same number of negatives for little more than a third of that sum. It will be some time before I have saved enough to repay me for the expenditure of £17 10s. on the lens and shutter, but when I consider the pleasure obtained from designing, building and using the camera, I cannot feel that it owes me very much.

A free-lance SHOWMAN'S ENGINE



By "Hallam"

THE free-lance showman's engine pictured in the accompanying photographs had rather an unconventional beginning.

Her builder, Mr. E. T. A. Sims, of Newton Abbot in Devon, had for some time been toying with the idea of building a $1\frac{1}{2}$-in. scale traction engine, when he paid a visit to the nearby steam-roller depot. Chatting to the fitter there, the latter mentioned that a few years previously he had started to build a $1\frac{1}{2}$-in. scale steam roller, but his boiler-making activities had so disturbed the neighbours that he had been threatened with violence! In order to keep the peace, therefore, he had desisted, and as a result a boiler barrel, firebox, and a couple of hand-cut gears were going begging. So Mr. Sims bore them away in triumph, and that was the start of his engine.

The barrel was rolled up from $\frac{1}{8}$-in. steel plate, with a riveted seam, and after some work with a wire brush and emery cloth, it shone like a new pin. The steel firebox having been similarly treated, riveting was completed, and copper fire-tubes were fitted. These were expanded into the holes, and beaded over; they are five in number, and $\frac{1}{2}$ in. diameter.

As a safety precaution, Mr. Sims next had all the joints brazed, which was done at a local garage, since he had not the required heavy equipment.

With the boiler complete, and tested satisfactorily, other parts began to take shape, with the aid of a $2\frac{1}{2}$-in. centres "Rollo Elf" lathe. Like most family men, Mr. Sims has no cash to throw away, and all sorts of odds and ends from various sources were pressed into service.

After three attempts at a cylinder block, this was finally hewn from a chunk of solid steel; it has two high-pressure bores of $\frac{7}{8}$ in. diameter and $1\frac{1}{2}$-in. stroke. Pistons and valves are of phosphor-bronze, and there are three lubricators, one over each steam-chest and one for the regulator valve.

The crank, $\frac{5}{8}$ in. diameter, was brazed up, and connecting-rods were cut from the solid bar, with hacksaw, file, and elbow-grease. More hand work went into the trunk-guides, which were cut from a piece of rusty old 1 in. diameter water-pipe.

Only two of the gears were purchased, the others being cut by hand. In view of the labour which this involved, one cannot blame the builder for deciding to fit only one speed! The first-motion pinion can be slid into and out of engagement, of course, to allow the engine to run "stationary" when driving the dynamo, and the method used to make the splines may be of value to others who have only limited workshop facilities.

First of all, the positions of the four splines were set out carefully on the shaft. Centre-lines having been marked, they were centre-popped at every quarter-inch, and shallow holes were drilled with a $\frac{1}{16}$-in. drill at these places.

The holes were joined up and opened out, using a hacksaw blade in a suitable holder, and the four grooves were finished off by filing, using a thin file on edge. Strips of $\frac{1}{16}$ in. thick steel were laid on edge in the grooves, and brazed in position. Finally, all was cleaned up by filing. Corresponding grooves were cut in the bore of the pinion by hand, first with a hack-saw blade, and then by filing.

For the front wheel rims, patterns were made and duralumin castings obtained, with a view to keeping the weight down. Castings for the hind wheel rims were obtained from A. J. Every, and since these were beyond the capacity of Mr. Sims's lathe, the turning had to be done "outside." The hubs for all the wheels were fabricated; the hind wheels have 18 spokes each, and the front ones 12, cut from steel sheet.

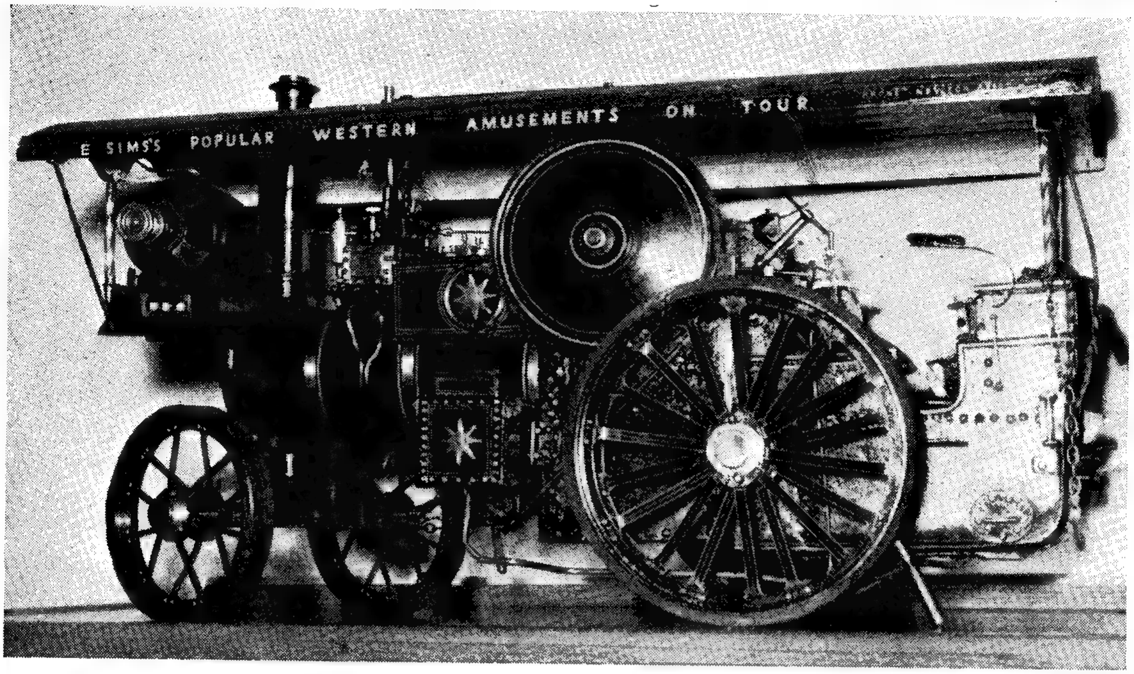
One example of "making do" is in the smokebox. This started as a $3\frac{3}{4}$ in. diameter water-pipe collar, of which the internal threads had to be turned away. The chimney cap was silver-soldered up from three separate pieces of brass.

Boiler fittings include a pressure-gauge, water-gauge, and test-cock (just above the level of the firebox crown). It is also fitted with a blow-down valve, so that the boiler can be blown out after every run. The heat of the boiler then dries it out; a desirable feature owing to its steel construction. A lead plug is fitted in the firebox crown as a precaution against low water.

The ashpan and grate are made in one, hinged at the back end, and the fire can be readily dropped by working a long handle from the footplate, resembling the ashpan damper handle of the prototype.

An eccentric-driven pump is mounted on the belly-tank, and has to be kept "on" all the time; the boiler is a very good steamer and blows off constantly even with a dull fire, so that consumption of water is fairly heavy.

The dynamo is an old one from a bicycle, "dressed up," and effectively lights up three bulbs under the canopy. The latter is made from $\frac{1}{2}$-in. $\times$ $\frac{1}{8}$-in. oak planks, painted cream underneath to reflect the light down on to the motion, and

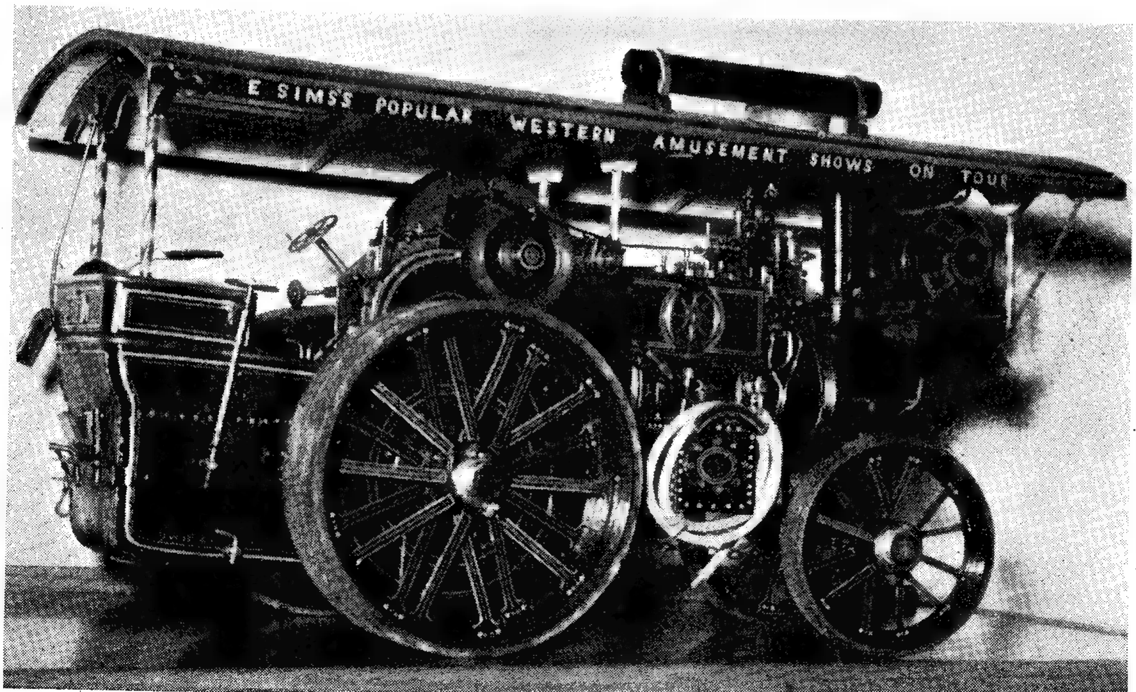


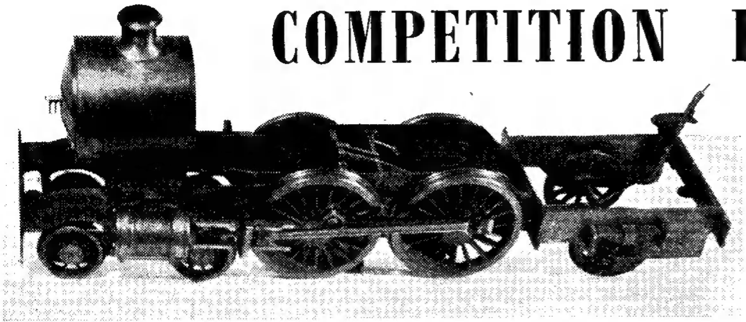
covered with thin linen (from an old blind) on top. Side sheets were made from the same material, incidentally. It is the correct green colour, and the engine looks well when sheeted up.

Painting is in typical showman's colours, with maroon boiler, tender, and wheels, lined out in black, gold, primrose and red; the rivets are picked out alternately in the two last colours. Hub-caps are chromed.

Although the engine is a free-lance, she was built having in mind both Burrell and Aveling features, and so bears these names on the smokebox door, fretted out in brass. Her name-plate *Jack Pack*, mounted on the dynamo platform, is in memory of an old driver of

(*Continued on page* 515)





COMPETITION EVENING AT WAKEFIELD

By "Northerner"

THE Wakefield Society of Model Engineers has not been in existence very long—it was formed less than eighteen months ago—but already a member has achieved the proud position of annexing a Championship Cup at the London exhibition. This was last year, when Mr. L. R. Raper, President of the Society, won the cup with his beautiful 0-6-0 tank locomotive.

Recently at Wakefield I had the pleasure of attending a Competition Evening when between twenty and thirty models were on view. A few of these were finished but most were not; several of the models were on loan only including Mr. Raper's locomotive and Mr. R. W. Wood's lovely table engine which I described in THE MODEL ENGINEER last year. Incidentally, we now had the pleasure of seeing this model in motion, Mr. Wood having brought with him from Leeds a small air-compressor for the purpose. A pretty sight indeed !

The judges were Mr. Wood and Mr. W. J. Hughes, and (as is usual on these occasions !) they had a very difficult task indeed. The Wakefield lads are good craftsmen, no doubt of that !

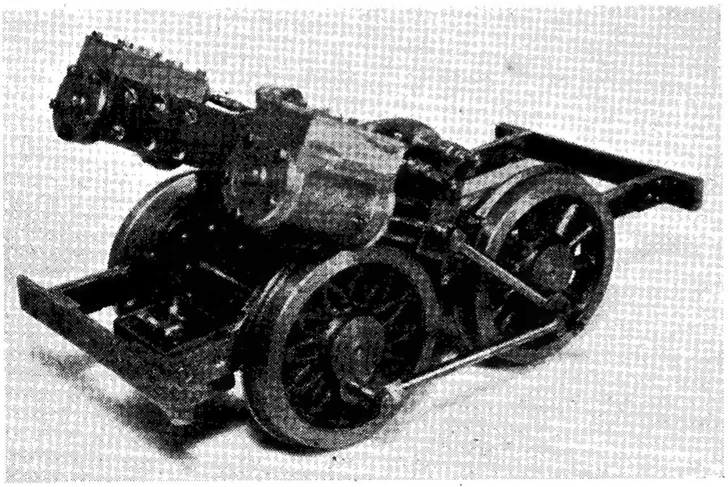
Eventually the first prize was awarded to R. H. Wagstaff, of Leeds, for his excellent $\frac{3}{4}$-in. scale chassis for an "Ivatt" Atlantic locomotive. (See photograph above.) This is being built partly to "L.B.S.C." and partly to official drawings from Doncaster.

Mr. Wagstaff had made his own patterns, and the castings had been done at a local foundry. The general finish of the parts was very good, and when one turned the wheels, there were no places where "binding" occurred; a good sign that everything was nicely lined up. Such details as the correctly cottered big-ends added to the realism, and I look forward to seeing this locomotive again when she is finished.

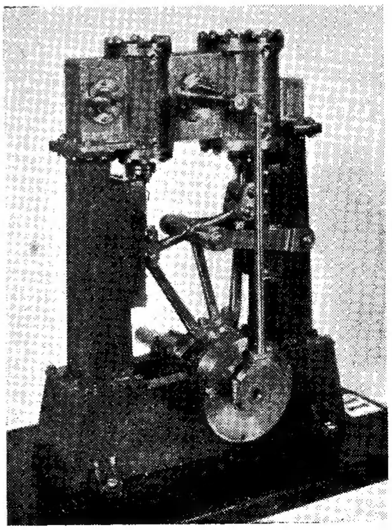
The winners of the other two prizes were locomotives also, the second going to J. Ward, of Stretford, for a free-lance $3\frac{1}{2}$-in. gauge 2-6-0, and the third to J. E. Lea, of Pontefract, for a $3\frac{1}{2}$-in. gauge *Invicta*, to "'L.B.S.C.'s' words and music."

Mr. Ward's engine was a worthy runner-up to the Atlantic; the finish was good, but the motion was not perhaps lined up to the same degree of accuracy; there was just a suspicion of a tightness in one place, though no doubt this will soon disappear in running. A "first attempt," the locomotive is to some extent based on "L.B.S.C." details, including the boiler and cylinders, but the valve-gear is to the builder's own design. This is another locomotive that will be worth a second inspection when finished.

Another photograph shows that "L.B.S.C." has a worthy young follower in John E. Lea, who is aged only sixteen; the craftsmanship on his *Invicta* chassis is astonishingly mature. It is true that he is an apprentice in engineering, but one has seen much worse work by model engineers of far greater experience—and this is John's first try. If he



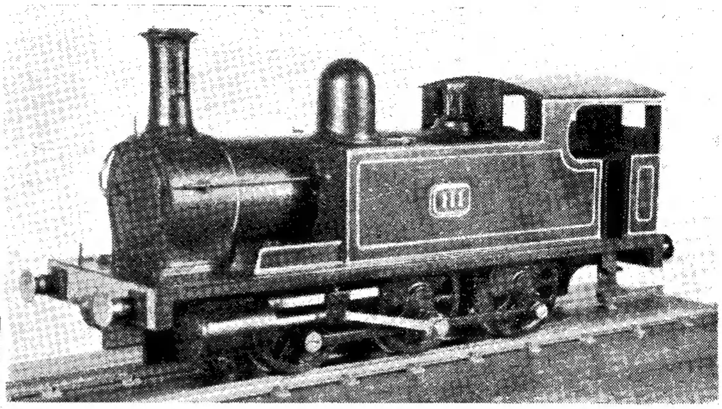
"*Canterbury Lamb*" *by* 16-*year-old J. E. Lea, of Pontefract, showing great promise for the future*



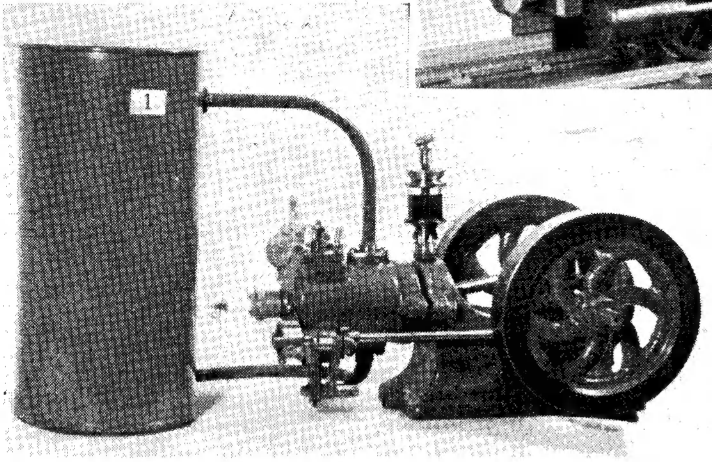
R. Elvy's compound mill-engine of uncommon design, with triangular connecting-rod

improves with practice and experience as one expects him to do, he should go far. Keep your eye on that Championship Cup, John lad!

A steam engine of unusual design is being built by R. Elvy of Wakefield, being a compound mill engine of which the prototype was built in 1897 by Fleming and Ferguson of Paisley. In this design both the H.P. and L.P. cylinders are coupled to the same crank by means of a triangular connecting-rod, and Corliss valve-gear is fitted. The model is being built from a plate in the book *Steam and Steam Engines*, by Andrew Jamieson, published in 1899.



Peter Ward's "O"-gauge North London locomotive, another "junior" effort, was also V.H.C.



Another V.H.C. was this petrol engine built by J. D. Walford

The only i.c. engine in the competition was that shown by J. D. Walford of Wakefield, of $1\frac{1}{2}$-in. bore by 2-in. stroke. This had been built from commercial castings, and though designed as a gas engine, had been altered by Mr. Walford to run on petrol. Of typical design for this type of machine, the engine was well-finished both as to bright and painted parts.

Back to a locomotive again; this time an "O"-gauge electrically-driven model of a North London Railway 0-6-0 tank. This had been built by another young entrant, Peter Ward, who I understand is now doing his period of National Service, and one of Mr. Hambleton's *Locomotives Worth Modelling* was the source of inspiration in this case. The mechanism had been purchased, though fitted with different side plates, and much of the turning work had been done by Peter's brother, whom we have already noticed. But the sheet work was very well done, and the finish was really excellent. It is very good to know that the Wakefield Society possesses younger members of excellent calibre; they are worth encouraging, and from all one hears, encouraged they will be by their seniors in the club.

One word more! Among the loan models was Mr. Raper's latest effort, a part-finished chassis for an "Aspinall" 0-6-0 goods engine, and this looks as if the finished job will be as good as last year's cup-winner. If so, it will take a major effort on someone's part to stop Mr. Raper having another "M.E." Cup on his sideboard after some future show!

A Free-lance Showman's Engine

(*Continued from page* 513)

that name who years ago used to give Mr. Sims rides on the footplate of a Burrell general-purpose traction engine.

With a boiler-pressure of 70 lb., the engine has easily hauled 6 cwt., and is capable of more. At the Newton Abbot exhibition she was constantly under steam for five hours, generating all the time, and rocking in the manner known and loved by all traction fans. She was awarded a bronze plaque at an Arts and Crafts Exhibition held at Swindon by British Railways—Mr. Sims is an engine-driver on the Western section.

The chief dimensions are: L.O.A. 31 in.; width 13 in.; height 19 in.; front wheels (over tyres) 6 in; hind wheels (over tyres) 10 in.; weight 100 lb. in working order. Accessories include whistle, wire winding-rope (Bowden cable), bucket, flue brush, poker, shovel, clinker shovel, chains, scotches, lifting jack, spanners, and driving mirror.

So now, after over three years' work, with at least one or two hours spent on her every day, Mr. Sims' dreams have come true, and he possesses a real "live steam" road locomotive. She is unorthodox in one or two respects—the double cylinders and the single speed—but in view of his difficulties perhaps we can excuse him that! Meantime, he has had a lot of fun in building her, and will have a lot more in steaming her on future occasions. And, perhaps above all, he has that most satisfactory sense of achievement which is engendered by the knowledge that something has been attempted, and something done!

The photographs were taken by Charles A. Doran of Newton Abbot.

QUERIES AND REPLIES

" THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked " Query " and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Power for Small Lathe

I have an indoor workshop equipped with a 2½-in. E.W. lathe which is at present driven by a 1/6 h.p. motor. The hum from this motor is found rather objectionable, and I am proposing to change it for a new motor of the resilient-mounted type with sleeve bearings, which I understand is noiseless. I have wondered whether the smaller motor would be sufficiently powerful for driving this lathe, as most of the work I propose to do in the future will be small. I have reason to believe that some of the motors recommended for driving lathes are more powerful than is really necessary.

W.C. (Glasgow).

It is quite possible that a ⅛ h.p. motor would be powerful enough for light work, but we think that a 1/6 h.p. motor would have a much better reserve of power.

It is always advisable to have a little power in hand, and this does not necessarily entail higher current consumption or noise. In fact, a large motor working on a comparatively low load will usually make less noise than a small motor working at full load.

Finishing Cylinder Bores

I have machined a cylinder for a petrol engine of 1⅛ in. bore from " Ubas " steel. The bore is quite accurate, but it shows tool marks, and I am wondering whether it would be advisable to make a dummy piston to lap this out until entirely smooth.

J.B. (Shrewsbury).

The particular grade of steel you are using is not ideal for a cylinder bore unless it is given some kind of surface hardening, but engine cylinders have been made from similar material and have given reasonably good results. The best way of finishing the surfaces is by lapping, but a dummy piston as you suggest does not constitute the best possible form of lapping. It is, generally speaking, advisable to use an expanding type of lap, which may be made from any fairly soft material such as aluminium or copper, and for initial lapping, carborundum paste may be used. Finishing should be carried out with successively finer grades of abrasive, preferably on new laps, finishing with Tripoli or other polishing abrasive. Great care should be taken to remove all traces of the abrasive medium from the surface of the bore, and any interstices such as ports, before running the engine. An article on the subject of lapping appeared in THE MODEL ENGINEER in issues dated April 13th and 27th, 1945. This will give you full details of the methods employed.

" Kestrel " 2-stroke Engine

I am making a " Kestrel " 5 c.c. 2-stroke engine from the " M.E." drawings, and so far have made good progress, but should be glad of some additional information about this engine

(1) *Where can suitable piston rings be obtained, and what is the correct specification ?*

(2) *Are platinum points needed on the contact-breaker, and what material is used for the contact-breaker arm, and also the insulating washers ? What means are recommended to render petrol-tight the joint between the castings of the fuel container and the disc which forms the end plate.*

(3) *Are the articles dealing with this engine still available, if not, what is the date of publication of the articles in* THE MODEL ENGINEER ?

F.R.S. (Dorking).

(1) We regret that we cannot advise you where piston rings for this engine can be obtained at the present time. It will, however, be perfectly satisfactory to use a cast iron piston machined to fit the cylinder very closely, though this demands an extremely high accuracy in both piston and cylinder.

(2) Platinum points are not necessary on the contact-breaker, as perfectly satisfactory results are obtainable with tungsten tipped points. The moving contact for this engine is mounted on a spring blade which should be made of tempered spring steel. The insulating washers may be made of fibre, ebonite or bakelite. The contact faces of the closing disc at the back of the crank case should be coated with shellac or other joint varnish and left to dry thoroughly before petrol is put in the tank.

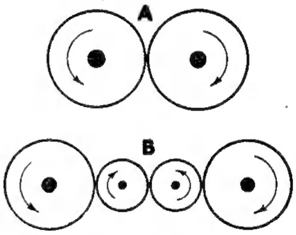
(3) The engine was described in THE MODEL ENGINEER in 1937 and 1938, and we regret that copies of the issues containing a description of the engine are not longer available.

Twin Marine Engines

I have two slide-valve double-acting marine engines which I propose using in a boat driven by twin screws. Is it necessary to couple the engines together ? Assuming that coupling is necessary, could this be done by fitting rubber rings on the engine flywheels so that they press against each other, thus connecting up the engines ?

S.T. (Manchester).

Yes, it is preferable to couple up the two engines, but the use of gear wheels would be much better than rubber rings. The gear wheels need not be very wide, as the power transmission in your case is not great.



As shown in the accompanying illustration, where the propeller shafts are close together, the arrangement would be as at " A." Where the shafts are farther apart the arrangement at " B " would be employed.

Casting a Boiler

Is it practicable to cast a boiler shell in copper to work at a pressure of 80 lb. per sq. in. ? The dimensions of the boiler are 2 ft. 10 in. long by 6 in. dia. by $\frac{3}{16}$ in. thick.

G.R.T. (Ham, Richmond).

We do not consider that it would be desirable to cast a boiler in copper. Copper is not generally regarded as a very suitable material for making castings, and in the event of any porosity in the casting, serious

leakage or weakening of the boiler would be produced, which would be very difficult to detect before the boiler was finished.

A copper casting would also be very much inferior in tensile strength than one built up from rolled copper plates. It is also extremely doubtful whether any economy would be effected in the cost of the boiler, as it would probably be necessary to make the walls much thicker than normal for convenience in casting.

Building a Centre-flue Boiler

I have decided to build a marine type boiler (centre-flue) and have purchased 12 in. ×. 3 in. diameter copper tube 0.032 in. thick, which, when completed, I propose to steam at 60 lb. pressure. I have, however, been informed that a boiler of this type would explode, and that the material of any boiler should not be less than $\frac{1}{16}$ in. thick. I would appreciate your help in this matter.

C.B. (Acton, W.3.)

We would not go so far as to say that no boiler should be less than $\frac{1}{16}$ in. thick, and much will depend upon the size and arrangement of the boiler components such as steam or water drums, but we do think that a thickness of 0.032 in. is very much on the thin side for safety in a boiler of 3 in. diameter working at 60 lb. per sq. in.

The fact is that it is usually found desirable to make small boilers to a very high margin of safety, and calculations based on the theoretical strength of metals have not generally been found reliable. It is necessary to allow not only for withstanding pressure when the boiler is new, but also after some deterioration has taken place as a result of either age or working conditions. Copper tends to deteriorate with age, and may also become brittle as a result of repeated heating. It would be possible to increase the strength of the boiler shell by riveting or brazing well-fitted copper bands on to the outside about 1 in. apart.

A boiler should always be given a hydraulic test when new, up to no less than 50 per cent. over normal working pressure, and any tendency for bulging or distortion of the boiler under pressure very carefully watched. If there is no appreciable distortion at the full test pressure, the boiler may be regarded as fairly safe, but the tests should be repeated at fairly frequent intervals to see that no serious deterioration has taken place.

WITH THE CLUBS

The S.M.E.E.

There will be a "film show" at the Caxton Hall on Thursday, April 23rd, 7 p.m. This has been arranged by Mr. E. T. Bartlett who has kindly relieved Mr. D. H. Chaddock as programme secretary.

The visit to the Tower Bridge has been postponed by the authorities until April 25th. They have also limited the party to ten only. A second party will be allowed in September at a date to be arranged. Those members who applied for this visit and were not in the first group will be included in the second party. Those included have been notified by postcard.

The "track meeting" on March 28th was a most successful event. The weather was kind, there was a fine display of engines and a good attendance of members and visitors, several from the Croydon Society led by Mr. Miles with his track.

Full particulars of the society may be obtained from the Secretary, E. C. YALDEN, M.C., 31, Longdon Wood, Keston, Kent.

Croydon S.M.E.

The above society will be holding its annual competition on Saturday, April 25th, starting at 3 p.m., at its headquarters, 1, Duppas Hill, South Croydon. There are various cups and prizes to be awarded for different sections. Visitors will be very welcome.

Hon. Secretary: E. R. VAN COOTEN, 29, Kingsdown Avenue, South Croydon.

Hull M.E.S.

The society will hold its annual meeting at 7.45 p.m. on April 23rd, 1953, at the Trades & Labour Club, Beverley Road, Hull. Will all members and intending members please attend.

Hon. Secretary: G. S. SHEPHERDSON, 25, Dryden Street, Westcott Street, Hull.

The Tonbridge and District M.R.C.

At our annual general meeting held recently, the following were elected:—Mr. E. Killick, chairman; Mr. W. Orpwood, treasurer; Mr. A. C. Gale, hon. secretary.

The committee consists of Messrs. Smith, Butler and Gregory. The librarian is Mr. H. Weskitt.

Our exhibition is being held at the Social Centre, Tonbridge, on April 29th and 30th, and May 1st and 2nd.

New members welcome. Particulars from the Hon. Secretary, 185, High Street, Tonbridge.

Eltham and District Loco Society

The next meeting will take place at the Beehive Hotel, Eltham, at 7.30 p.m., on Thursday, May 7th, when Mr. Hutton, the chairman, will give one of his popular talks on "Locomotive Construction." These talks are always very interesting—especially to beginners.

At the annual general meeting Mr. A. Brock was elected vice-chairman in lieu of Mr. Weedon who, we regret, is having to leave us owing to business reasons. We shall miss Mr. Weedon, with his cheery personality, and especially his stud of locomotives. Some society in the North of England will be very fortunate in securing Mr. Weedon's membership. Mr. Connor was elected assistant secretary in lieu of Mr. Brock who relinquished that post on appointment to vice-chairman.

Applications for the society's portable track and locomotives are now coming in, and it looks like having another busy season. Visitors are always cordially invited to the meetings.

Hon. Secretary: F. BRADFORD, 19, South Park Crescent, S.E.6.

Southend M.R. & E. Circle

A club exhibition will be held at Priory Park on Saturday, June 6th (all day). All club members are asked to contribute models.

Some members will be visiting Mr. Norris at home with his 4 mm. layouts on Sunday, June 14th.

Mr. B. S. H. Smith, A.M.I.E.D., will give a lecture on model bridge building on Thursday, July 2nd.

Filmshows, which were held up, will now be under way once again, due to the kind assistance of a member of the S.M.P.B. Club.

Hon. Secretary: A. L. HOOPER, 10, Boston Avenue, Southend-on-Sea.

THE MODEL ENGINEER DIARY

April 29th, 30th, May 1st, 2nd.—Tonbridge and District Model Railway Club.—Exhibition at the Social Centre, Tonbridge.

May 3rd.—"Model Ships and Power Boats" Radio regatta at Hove Lagoon, Hove, Sussex. Model yachts under radio control, commencing at 2.30 p.m.

May 4th, 5th, 6th, 7th, 8th and 9th.—Birmingham Society of Model Engineers.—Exhibition at Bingley Hall, Birmingham.

May 8th, 9th, 10th.—Farnborough Society of Model Engineers.—Annual exhibition at the Town Hall, Farnborough, Hants.

May 10th.—South Eastern Association of Model Engineering Societies.—Regatta for straight-running boats at Brockwell Park, Herne Hill, starting at 11 a.m.

May 17th.—Model Power Boat Association.—Coronation speed regatta at Victoria Park, Hackney, London, E.9.

NOTICES

The Annual Subscription is £2 2s. 0d., post free, to all parts of the world.

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.